THE

# ELECTRICAL REVIEW.

VOL. XXXVIII. JANUARY 10, 1896. No. 946.

## CONTENTS:


| | PAGE |
|---|---|
| "Delayed in Transmission" | 31 |
| High Tension and Low Tension Supply | 33 |
| The Submarine Boat "Le Goubet" (*illustrated*) | 35 |
| Loss of Revenue due to Transformer Leakage Current | 37 |
| Gaseous Fuels | 38 |
| The Cable Repair Steamer "Mackay-Bennett" (*illustrated*) | 40 |
| "Past and Present Obstacles in the Storage Battery Development" | 42 |
| The Merchandise Marks Act | 43 |
| Tests of a 10-H.P. De Laval Steam Turbine (*illustrated*) | 44 |
| The Telegraph to the Cape | 46 |
| Correspondence:— | |
| The Preliminary Examination in Electric Lighting | 47 |
| The Geometrical Form of Transformer Plates | 47 |
| Fire at Electric Lighting Stations | 47 |
| Earthed Centre Main | 47 |
| The Audit of Electric Lighting Company Accounts | 47 |
| Business Notices, &c. | 48 |
| Electric Lighting Notes | 50 |
| Electric Traction and Motive Power Notes | 51 |
| Telegraph and Telephone Notes | 51 |
| Contracts Open and Closed | 52 |
| Notes | 52 |
| City Notes | 54 |
| Traffic Receipts | 54 |
| Share List of Electrical Companies | 55 |
| Reviews:—Fisica Tecnologica | 56 |
| Submarine Telegraphy and Other Papers | 57 |
| The Electrical Transmission of Energy | 57 |
| Gleanings from Patent Laws of all Countries | 57 |
| Theorie de L'Electricité | 57 |
| Electric Traction in Australia | 57 |
| Past and Present Obstacles in the Storage Battery Development | 58 |
| Provisional Orders | 60 |
| New Patents | 61 |
| Abstract of Published Specifications | 62 |


THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

PRICE 4/- POST FREE. The Leading Electrical Trades Directory and the Oldest Electrical Directory in the World.

1895 ISSUE

PRICE 4/- POST FREE. Fully Revised and Thoroughly Reliable. Contains a larger amount of Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,

22, Paternoster Row, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

*The Oldest Weekly Electrical Paper. Established* 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—22, PATERNOSTER ROW, LONDON.

Telegraphic Address: "ACKNEAT, LONDON." Code A B C. Telephone No. 517.

*ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.*

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades

*SUBSCRIPTION RATES.*—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other Countries*, per Year, £1 4s.

*BINDING.*—Subscribers' numbers bound, including case, for 4s. each volume.

*CASES.*—Cloth Cases for Binding can be had, price 2s. 6d. each.

*FOREIGN AGENTS.*—*New York*: D. VAN NOSTRAND, 23, Murray Street. *Paris*: VEUVE J. BOYVEAU, 23, Rue de la Banque. *Berlin*: ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to MR. H. ALABASTER, 22, Paternoster Row, E.C.

## "DELAYED IN TRANSMISSION."

DURING the critical and anxious period of affairs in the Transvaal which has sprung up with the New Year, the public has been made painfully familiar with the words which we have chosen as a heading for this article. To the delay in telegraphic communication with the Cape may be ascribed the numerous and sometimes alarming rumours which have been so widely circulated, rumours which could not have arisen had the public been from day to day in possession of the actual history of events in South Africa. This knowledge would in all probability have gone far to minimise, and certainly could not have justified, the torrent of reproach with which Her Majesty's Government has been assailed by the Continental Press, which has been as scantily informed as the press of our own country.

Various suppositions have been advanced to account for the dearth of news from the Cape. Dr. Jameson, according to one report, had cut the wires. President Kruger, according to another version, had prohibited the transmission of telegrams, and, lastly, the Imperial authorities were said to have monopolised the line, to the exclusion of Press and private messages. Of these, the last seemed the most probable, and certainly the most justifiable reason.

But apart from these guesses, we know that the cable route from Natal to England was rendered useless when most required by the interruption on Christmas Eve of the Aden-Zanzibar section of the Eastern and South African Telegraph Company's system (which was not repaired till last Saturday), thus throwing all the traffic from South Africa on to the line which runs northward from Cape Town along the West Coast of Africa. In following this cable northward, we find that it touches at Accra, at which station telegrams concerning the expeditionary force to Ashanti are sent and received, and as from Accra there is only a single cable on to Sierra Leone, it is not to be wondered at that a congestion of the traffic has occurred, and that much delay in the transmission of telegrams should be the natural result. It is worth noting here that we owe the existence of this cable route along the West Coast of Africa primarily to the initiative of Portugal, the Government of which country desiring to be in telegraphic touch with her Colonies gave a guarantee of traffic for the period of 25 years equivalent to a sum of £42,000 per annum. The French Government, availing themselves of this opportunity of reaching their possessions, gave conditional subsidies amounting to £12,000 yearly for 23 years. Her Majesty's Government, in connection with these West African cables, contributes a subsidy of £19,000 per annum for 20 years; and, lastly, the German Government, for the same duration of time, gives a yearly subsidy of £6,700 for a branch line to the Cameroons. If taken together, the figures detailed above give a yearly amount of £79,700. At the time of its inception, the idea

of extending a cable system along the West African Coast met with much unfavourable and adverse criticism in quarters which we need not specify. We may, perhaps, be pardoned for recalling here, with a certain amount of pleasure, that from the beginning this project met with our support.

To turn to the alternative route which runs from Natal along the east coast of Africa, and which has the unenviable claim of seniority. Our readers may recollect that this line owes its existence to the need for communication so strongly illustrated during the Zulu war, and that cables were laid in 1879 which united Natal with the Eastern Telegraph Company's lines at Aden. To assist this project a 20 years' subsidy, amounting to £60,000 per annum, was guaranteed to the company undertaking the work by the Governments of England and Portugal, in conjunction with the Cape of Good Hope and Natal.

The same company (the Eastern and South African Telegraph Company) we may state in passing, receives from Her Majesty's Government a further annuity of £28,000 for cables which join Mauritius and the Seychelles to its line at Zanzibar.

We have at some length indicated above the favourable conditions under which the telegraph lines to South Africa are worked, conditions which fully justify the Government, the Public, and the Press, in expecting an efficient telegraph service, more especially in times of national anxiety such as the present. To such expectations the excuse, "delayed in transmission," is a very poor answer. That unfortunate and ill-timed cable breakdowns may occur is only a good reason for making provision against their consequences, and in our opinion the Eastern and South African Company are very much to blame in this particular. The experience they have had may be gathered from a list of interruptions to their cables, which we publish elsewhere. It was only last September that the Aden-Zanzibar cable was interrupted for a month, and this, too, at the time when a rising had taken place amongst the native tribes near Mombasa. We may mention that this company has paid away in dividends to its shareholders out of earnings, in less than 10 years, a sum which exceeds the amount of its share capital, and this irrespective of the subsidies received from various governments.

It will be seen that the duplication of the Aden-Zanzibar cable might reasonably have been carried out, and thus, in a moment of grave emergency, we should have been spared the foot-note at present attached to many of the telegrams from South Africa.

---

The De Laval Steam Turbine.

THE paper which we print on another page gives particulars of tests made upon the De Laval steam turbine, a species of heat engine which is likely, we fancy in the future, to find a large field. This turbine is of the impulse type, the steam supplied to it having been allowed to expand in a spreading nozzle and attain a high velocity before being delivered upon the wheel. Theoretically, therefore, the speed of the ring of buckets ought to be one-half that of the steam jet. Seeing that there is no temperature range in the parts in contact with the steam, it follows there can be none of the mischievous action of the metal found in all ordinary cylinders and summed up in the term cylinder-condensation. The absence of this fault ought to go a long way towards securing economical working of turbines. Of course, the imperfections of the jet and the difficulty, perhaps, in running a wheel as fast as theory would indicate as proper are responsible for any failure in this direction of economy hitherto observed. The value of high speed in reducing dimensions is very striking. Here we have a small wheel, less than 6 inches in its maximum diameter and carried on a $\frac{5}{16}$-inch steel spindle, yet the output is 10 H.P. Its helical toothed driving wheel is only $1\frac{1}{8}$ diameter, and speed is reduced nearly ten times in the first gear and still leaves a speed of over 40 revolutions per second in the second motion shaft. Attention is drawn to the rapid decrease of efficiency when the governor throttled the supply, and the obvious suggestion is made that governing should be by cutting out one or more of the nozzles rather than by throttling. The steam consumption at best fell to 47·8 pounds per H.P. hour, the horse-power being the brake horse-power, and it is claimed not to be a bad result for only a 10 horse motor. Owing to the difficulty in securing an actual balance in so rapidly revolving a piece which can never be made perfectly homogeneous, and, therefore, cannot have its C. G. exactly coincident with its lathe centreing, the turbine is placed on a long unsupported length of spindle and advantage thus taken of the fact that compound bodies tend to revolve about their common centre of gravity. In this way the turbine fixes its own centre of rotation and so revolves freely and without noise. It will be noted that the velocity of the centre of the buckets is about 570 feet per second. Doubling this figure we get 1,140 feet per second, which is considerably under the velocity of efflux of steam of the pressure employed, and we should be inclined to look for better efficiency when it is found possible to use wheels at still higher rates of revolution.

---

A Knowledge of Principles Wanted.

IT is surprising that the spread of technical education has not done something to remove the prejudices and ignorances that have for years existed regarding certain common things in interior wiring. It is, however, a fact that, simple as many of these things are, they are not yet properly understood by wiremen generally, and even some foremen and superintending engineers might be the better for a little grounding in first principles. Quite recently we heard of a gentleman who had occasion to use a metre bridge and, for use with it, chose, from a number of galvanometers, a tangent instrument under the impression that, as he had heard that the galvanometer should be of the same order of resistance as his bridge coils, and its coils were of a lower resistance than the others, it was best suited to his purpose. Another relic of the past is the supposition that a wire painted red is something different from a wire painted black. The use of differently coloured wire for the two conductors in interior work may possess some slight advantages, but many years ago Messrs. Drake & Gorham pointed out that red wire was not so well protected and generally satisfactory as black, and recent experience, in our case, has supported this statement. If the distinctive colours are used they should be understood clearly to be merely aids in such cases as may crop up from time to time where it is advantageous to know which wire is which. As, however, it has been the practice with many contractors to purchase cable, half of which is coated with red compound and the other half with black, the fact should be impressed upon those who use it that a blind reliance upon the principle of always connecting red to red and black to black may lead one into mistakes. Thus, for example, we knew of a case a short time ago where a number of switch wires were brought down to a controlling board on which was also placed a double-pole switch to control another circuit below. Evidently the leads for this were at the full difference of potential and had to be treated as such, whereas the switch leads were on the same side of the circuit, and although, when the switches were off, they had the full pressure between them, the moment a current passed the pressure fell, due to the lamp resistance. Yet it was imagined that a "short" would be equally destructive, and that the fuses at the junction with the mains would blow if any fault came on. Here is a point for our technical teachers to make clear to their "practical" students, and if they succeed in bringing light to the minds that previously were dark on this subject, some real good will have been done.

## HIGH TENSION AND LOW TENSION SUPPLY.

By ALBERT GAY.

Of all the debatable subjects that have from time to time engrossed the attention of electrical engineers, probably the most interesting is that of high tension compared with low tension supply.

As soon as electric lighting obtained a fair grip in this country, the fight began and has been carried on relentlessly ever since. Each side has persistently closed its eyes to the merits of the other, and a great deal of resentment and ill feeling has resulted.

It is hopeless to expect that either side will ever be converted entirely to the opinions of the other, but it is surely possible to declare a truce and for the subject to be calmly and dispassionately considered with a view to bringing about a better feeling.

There are plenty of obstacles to overcome and mutual enemies to fight, and valuable time should not be wasted in a wordy warfare that is at once profitless and absurd.

It is with a view to reminding the combatants and showing them as fairly as possible how fruitless such a warfare must be, that the present article has been written, and if it is the means of reducing the friction, even in the smallest degree, the desired end will have been attained. It may be interesting at the outset to enumerate the alleged faults of each system as seen by its opponents.

The votaries of the high tension alternating system have said that the chief faults of low tension supply are :—

1. Large capital outlay on mains.
2. Heavy loss in distribution.
3. Bad regulation as compared with high tension.
4. Complications in distribution, multiple wires, &c.
5. Fixed pressure, with inability to meet special cases except by means of expensive and cumbersome apparatus.
6. Supply confined to restricted areas.

While they claim that all these difficulties are avoided by using their system.

### 1.—Large Capital Outlay on Mains.

In analysing each item in turn we must admit that the first is probably true, but is it of so much importance as the high tension people pretend ?

In judging the cost of any system, the capital expenditure on the *whole* must be considered and not only that on any one part of the work.

Unfortunately the accounts for 1895 are not yet published, but those for 1894 are available, and it will here be found that the Notting Hill Company with a low tension system and a capacity of 375 kilowatts, has spent about £208 per kilowatt, while Oxford, which has adopted a high tension continuous system, with a capacity of 240 kilowatts, has spent £260 per kilowatt. The City Company with an alternating system, has spent £179 per kilowatt, with a capacity of 5,120 kilowatts, and there is no reason to suppose that the Notting Hill Company's expenditure per kilowatt will exceed that of the City Company when its capacity is equal to the latter.

In the case of local authorities, we find that Burton with a high tension alternating system and a capacity of 198 kilowatts, cost £136 per kilowatt, while Oldham, with low tension and a capacity of 192 kilowatts, cost £132 per kilowatt.

The cases quoted above are those showing the highest expenditure ; those showing the lowest expenditure are as follows ;—

Southampton Company, low tension, 200 kilowatts capacity, £86 per kilowatt. Newcastle District Company, 969 kilowatts capacity, £53 per kilowatt.

Lancaster Corporation, low tension, 288 kilowatts capacity, £53 per kilowatt. Henley, high tension, 324 kilowatts, £66 per kilowatt. I give these figures again in tabulated form :—

| High Tension. | | | Low Tension. | | |
|---|---|---|---|---|---|
| Company. | Capacity. | Cost per kw. | Company. | Capacity. | Cost per kw. |
| City of London | 5,120 kw. | £179 | Notting Hill ..... | 375 kw. | £208 |
| Oxford (contns.) | 240 „ | 260 | Southampton ... | 200 „ | 86 |
| Newcastle Dist. | 969 „ | 53 | | | |
| Local authority. | Capacity. | Cost per kw. | Local authority. | Capacity. | Cost per kw. |
| Burton..... | 198 kw. | £136 | Oldham..... | 192 kw. | £132 |
| Hanley..... | 324 „ | 66 | Lancaster..... | 288 „ | 53 |

The average cost per kilowatt of all the works in Great Britain is as follows :—Low tension, £109 ; high tension, £104. This, however, includes Oxford, which is a high-tension continuous current station. If this is excluded, it reduces the average for high-tension stations to £97 per kw.

Local conditions in each case may materially affect the cost per kilowatt, and in order to arrive at a really just conclusion, each case would have to be judged upon its merits, *e.g.*, one station may consist of simple buildings, sufficient for immediate requirements only, and considerable and expensive alterations may be necessary on extension ; in this case the total cost per kilowatt will *rise*, although the first cost will be low ; or considerable provision may be made for extension at an increased first cost, in which case the total cost per kilowatt will *fall* on extension. Again, the cost of land must be considered, and whether or not the site has been purchased outright or only held on annual rental, &c. But taking the above figures as a basis, there does not appear to be much in the contention that the capital outlay on a low tension system is necessarily greater than that on a high tension system.

### II.—Heavy Loss in Distribution.

Here, again, the economy of the system as a whole can only be considered, and this can be judged by again referring to the accounts for 1894.

In the case of companies, the Liverpool Company shows the lowest works cost, with 1·6d. per unit* and an output of 1,016,000 units, the system being low tension. The high tension company showing the lowest works cost is the Newcastle District with 1·82d. per unit and 431,000 units output.

In the case of local authorities, Manchester shows a works cost of 1·49d., and an output of 1,168,000 units, the system being low tension, while Portsmouth a works cost of 1·59d. per unit, and an output of 160,000, units is a high tension system.

It is equally difficult to arrive at a fair conclusion in the case of working cost, as in the case of capital expenditure, so much depends upon local conditions, *e.g.*, cost of fuel, water, wages, and whether or not water is available for condensing, &c.

For convenience I also give these figures in tabulated form :—

| High Tension. | | | Low Tension. | | |
|---|---|---|---|---|---|
| Company. | Output, units. | Works cost. | Company. | Output, units. | Works cost. |
| Newcastle Dist. | 431,000 | 1·82d. | Liverpool Co. | 1,016,000 | 1·6d. |
| Local authority. | Output, units. | Works cost. | Local authority. | Output, units. | Works cost. |
| Portsmouth | 160,000 | 1·59d. | Manchester | 1,168,000 | 1·49d. |

The average works cost per unit of all the electric lighting undertakings in Great Britain whose accounts for 1894 are published, excluding Burton, where, for some reason the costs are abnormally high, are as follows :—

High tension 2·94. Low tension 2·34,

or rather more than a half-penny per unit in favour of low tension.

### 3.—Bad Regulation.

As compared with high tension systems there are doubtless some difficulties in this respect, and a considerable fall of voltage between two feeders at full load is sometimes experienced, while the introduction of 200 volt lamps and multiple wire systems seems to bear out this contention. As, however, the consumer is the sufferer and his remedy is in his own hands, and as the growth of low tension does not appear to have been checked in consequence, the whole matter may be left to the Board of Trade to see that their regulations are obeyed.

### 4.—Complications in Distribution, Multiple Wires, &c.

This is a matter which chiefly concerns the works engineer, and it must not be forgotten that some engineers have adopted the three-wire system of distribution in conjunction with high tension, and will doubtless acquire a taste for 200-volt lamps in the course of time.

### 5.—Fixed Pressure.

One of the chief claims of high tension advocates is, or was, the "flexibility of the system," *i.e.*, anybody could have any voltage he desired and without any great additional

* In all cases "the cost per unit" refers to units sold.

expense. While this is quite true it does not follow that any great demand will ever arise, and certainly does not now exist, for different pressures.

In isolated cases, such as electroplating, or electric welding, a lower voltage would be required than that of the distributing mains, but, as in the former case, an alternating motor driving a continuous current dynamo or some similar device would be necessary in the case of alternating current supply, and in the second case a number of storage cells or a motor transformer, in the case of low tension continuous current supply, little can be said on either side.

### 6.—Supply Confined to Restricted Areas.

If this is true it means one of two things, either the low tension people are evading their obligations or they have to erect a number of "central" stations.

The Board of Trade are probably smart enough to see that the first does not take place, and, as the erection of additional works does not appear, by the accounts, to materially affect the comparative capital outlay, the merit of the contention does not appear. Whether the comparative capital expenditure will increase in the future I must leave the future to decide.

Summarised, the result is as follows :—

| Statements. | Facts. |
|---|---|
| 1. Large capital outlay on mains. | *Quibble.* Total average capital expenditure, not greatly in excess of high tension. |
| 2. Heavy loss in distribution. | *Quibble.* Total average works costs less than high tension. |
| 3. Bad regulation as compared with high tension. | *Probably correct*, but not serious. |
| 4. Complications in distribution, multiple wires, &c. | *Quibble.* High tension systems using three wires, &c. |
| 5. Fixed pressure. | *Quibble.* |
| 6. Supply confined to restricted areas. | *Not established.* |

The supporters of the low tension system have, at various times, contended that the high tension system possesses the following disadvantages :—

1. Is dangerous.
2. High works costs.
3. Difficulty in maintaining insulation on mains.
4. Unsuitable for motors.
5. Cannot be stored ;

and they claim that with their system these disadvantages do not exist.

### 1.—Is Dangerous.

In view of the fact that high tension people do not supply to the house mains a higher pressure than 100 volts or thereabouts, while the low tension advocates are clamouring for and using 200 volt lamps, the objection is scarcely a rational one. Again, they are asking that the term "low tension" shall include 600 volts !

Time was when they swore by 100 volts, or 110 at the outside, with 220 on the outer conductors of a 3-wire system, and a sudden advance to nearly three times that figure is surely a sign of the times and a forecast of that blessed period when the lion will lie down with the lamb.

It has been often stated that 600 volts is not dangerous, but have the advocates thereof the courage of their convictions—if *convictions* they are—and would they, in the interests of science, care to calmly accept a shock of 600 volts ? I think not. We have heard a good deal about people who have received shocks, but is there one authentic case supported by proper evidence in which anyone has, with a proper grip and moist hands, received a shock of 600 volts and lives to tell the tale ? if so, I am sure a detailed account would be welcomed by all. Ordinary shocks, which nearly every engineer has received, resulting in burnt fingers, are not evidence, as the resistance at the point of contact may have been very high indeed. Until this is settled the cry of danger by the low tension people cannot be admitted even in respect of the mains.

### 2.—High Works Costs.

At first sight the average works costs appear to bear this out ; high tension being 2·94d. and low tension being 2·34d. It must be remembered, however, that there are several of the older companies still using house transformers, and apparatus is not as efficient as can now be obtained, whose works costs are therefore high and tends to keep up the average. That it is possible for modern high tension stations to show lower works costs than those which have been running for some years, is proved by again referring to the accounts for 1894 where (with the exceptions of Cambridge, Scarborough, Kingston, and Burton, each of which had been in existence about a year when the accounts were published), all the companies and local undertakings, amounting to 10, that have been running for three years or less, and who are using the high tension system show works costs which, all totalled together and averaged, only equal 2·43d. per unit.

There is therefore no reason for assuming that the working cost of a high tension station is materially greater than that of a low tension one.

### 3.—Difficulty in Maintaining Insulation on Mains.

Several low tension undertakers have, during the past year or two, shown that high insulation on low tension mains is by no means common, and it must be remembered that when a continuous current breaks loose it generally does much more mischief than an alternating current.

### 4.—Unsuitable for Motors.

This objection cannot be maintained now, and even when first raised, the demand for motors was so small as to be scarcely worth consideration, and certainly not worth fighting about. When the demand becomes serious, I have no doubt the high tension people will be ready to meet it, and even now they can hold their own.

### 5.—Cannot be Stored.

Some high tension engineers say they consider this an advantage, but they are probably humorists. As a means of reserve in the works very few (comparatively) possess batteries of sufficient capacity to take over the work in the event of breakdown. The majority, if they use them at all, do so only for purposes of regulation, and this is not necessary with an alternating system.

As far as the consumer is concerned, he probably does not want storage on his premises, and would not have it if it was offered him, except in isolated cases, where if storage is necessary and he chooses to pay for it, an alternating motor and a continuous current dynamo gets over the difficulty.

Summarised, we find the following result :—

| Statements. | Facts. |
|---|---|
| 1. Is dangerous. | *Quibble.* They use a higher voltage in the house than high tension companies, and there is nothing to show that 600 volts is not also dangerous. |
| 2. High works costs. | *Not established.* |
| 3. Difficulty in maintaining insulation on mains. | *Quibble.* Pot calling the kettle "smut." |
| 4. Unsuitable for motors. | *Untrue.* Successful motors in the market. |
| 5. Cannot be stored. | *Quibble.* |

In reviewing the position it appears that while each side has been very busy in abusing the other, this has not prevented them from quietly poaching on each others preserves, and the result is that the low tension system, as it was known in 1890, no longer exists or in a very few cases only. While the high tension system with its house transformers and mechanically imperfect cables of hair like dimensions is rapidly becoming a thing of the past, nearly all the older companies being engaged in modernising their systems, the low tension in raising the pressure and the high tension in introducing low tension distribution. What will be the "system" in 10 years' time ? Who can say ? but in view of the serious changes which have taken place during five years, the condition of affairs at the end of the next ten will probably be interesting. In the meantime, let us hope that the coming year will be characterised by peace and goodwill amongst the followers of both high tension and low tension systems.

## THE SUBMARINE BOAT, "LE GOUBET."

The readers of *La Nature* will remember the articles that appeared in its columns relating to the submarine boat, *Le Goubet*.

The experiments made with this little vessel in 1890, at Cherbourg, before an official committee, were altogether favourable, and, if we only judge by the report of this committee, they seem to prove that it fulfils the various conditions required from a vessel of the kind.

We know, moreover, that since its appearance no other submarine vessel—except, perhaps, the *Zédé*, about which hangs a certain amount of mystery—has been so successful, and we have, therefore, no doubts as to the result of the launching of a *Goubet No.* 2, which has just taken place, the second model being sufficiently like the first to ensure its giving equally satisfactory results, and yet having undergone considerable revision and improvement.

We will recapitulate the essential characteristics of the *Goubet* boat (named after its inventor, as we know). Its shape is that of a spindle, formed by the revolution of an arc turning on its chord (fig. 3). The regularity of its outline is interrupted at the top by the dome or oval lid that opens to give access to the interior of the marine monster, and at the bottom by a kind of false keel which, whilst imparting exceptional stability to the apparatus, constitutes

Fig. 1.

a safeguard in cases of unforeseen emergency; upon one turn of a key being given by one of the staff, this weight is detached, leaving the floating part, which is thus suddenly lightened, to rise to the surface of the water like a cork.

In the horizontal middle plane, two thin wings run from end to end of the boat, counteracting the rolling movement and serving as a support to the self-propelled torpedoes which the boat carries when required.

We shall have completed the description of the outward appearance when we have mentioned the oars, the port-holes, the screw moving in its horizontal plane, effecting not only the propulsion but also the steering by a simple change in the orientation of its shaft, rendering any other rudder unnecessary. The jointed oars which, when not in use, lie along the boat, are fitted at their extremities with webs opening and folding up after the manner of a duck's foot in the double forward and backward movement. They pass through the boat through stuffing boxes forming rowlocks, and are worked from inside like ordinary oars.

The port-holes are the eyes of the boat. Fitted with thick glass, they are distributed at equal heights along the shell of the submarine boat, as well as on the top of the dome. They enable the light to be diffused through the hold, and it is through no defect of theirs if through the mass of water they do not enable one to see clearly beyond 10 or 12 metres; this is due to the medium by which they are surrounded, and the same disadvantage occurs in all submarine vessels. The new boat is the big brother of *Le Goubet No.* 1; the latter was only 6 metres long, and its bronze shell was cast in one piece, a difficult operation, but one which should inspire confidence in the timid.

*Le Goubet No.* 2 measures 8 metres in length, and has a diameter of 1·75 metres at the rowlocks. It weighs about 10 tons, and confidence being now acquired, it can be taken apart into three pieces, which are held together by inner collars securely bolted. The false keel alone weighs 1,200 kilogrammes.

We will suppose that the dome is open, and that we descend into the hold by an iron ladder, which is at once withdrawn, in order that the dome may be closed on its India-rubber packing.

Whereas in the first boat there was a little want of space, the two men forming the crew being obliged to sit back to back just in the axis of the ship, the new type is more roomy in the middle; the captain can take his place on a revolving seat, which enables him to look out through the port-holes in the dome; the two sailors who assist him are seated at the two extremities, opposite one another, each having within reach the con-

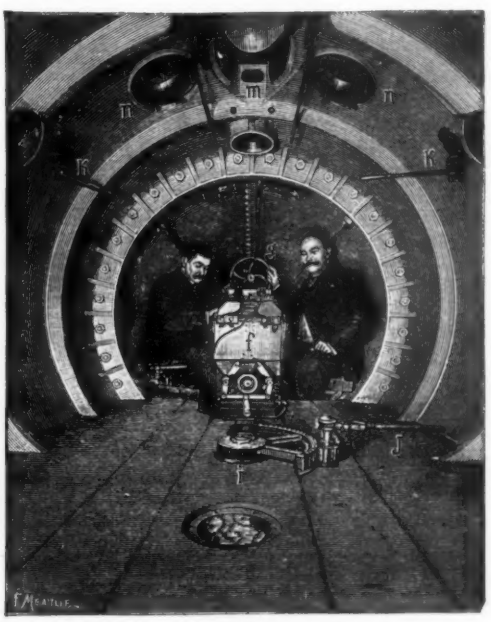

Fig. 2.

trolling appliances required for his work and shown in our figures. Let us turn to the fore-part (fig. 1); we see the man that works the oars. He has in front of him the handles, *a*, *a*, which enable him to open upon the sea the outlet of the pump, the taps of which are at *b*, *b*, and to expel, as required, and according to the position of the valves, the wheels of which are seen at *c*, *c*, the water, which serves as ballast, or the vitiated air, which, owing to the density of the carbonic acid, is condensed in the bottom of the boat. Behind his head, at *d*, is the "postal" apparatus, similar to the box, *d*, of a large tap, the cavity of which may be either opened to place in it the little watertight case containing despatches, or put in communication with a vertical chimney opening into the sea when the case rises to the surface of the water by its own specific lightness. The fore-part of the vessel also contains the steel tubes, holding, compressed into a small volume, the reserve stock of respirable air.

We will now turn towards the stern (fig. 2). There we see the electromotor which is worked by the batteries arranged along each side of the hold. The engine, above which we see the wheel that works the screw, hides the gearing and regulating mechanism; but we can see on the sides of the shell the bolts setting free the torpedoes placed outside on the

wings, and on the floor just under the dome, the handle, which gives a quarter of a turn to the bayonet hinge that keeps the false keel in position; this quarter of a turn is sufficient to detach this safeguard, and thus set free the floating part, which, at one bound, rises to the surface.

Such are, briefly, the essential parts of this submarine boat, and we can now easily become acquainted with their working.

In its normal state, the little vessel floats on the surface of the water, only the dome appearing above. The captain by looking through the port-holes that are out of the water can sweep the horizon and steer at his ease. It is very difficult to perceive from a distance this floating part, which is no bigger than a lifebuoy. But when we enter the zone of danger, the real work of the submarine vessel begins; on a little water being introduced into the bottom of the vessel, it is submerged to the required depth (4 or 5 metres generally, 10 metres, if necessary).

The port-holes are only a feeble aid in enabling the occupants of the boat to see around them; but an optical tube, consisting of a series of telescopic lenses, is then passed through the bronze shell. It reaches the surface of the water, and by means of total reflection prisms, enables the captain to observe everything that goes on at the surface.

The principal motor has then merely to effect the rectilineal motion, and to overcome the friction which, owing to the shape of the shell, is not considerable. With a motor developing 2 to 3 H.P., which is very little, *Le Goubet No.* 1 could get up a speed of 4 to 5 knots an hour.* A motor a little more powerful will impart still greater speed to the new boat.

To supply the necessary energy to the electromotor, the inventor employs a bisulphate of mercury battery, doing away with accumulators; for whatever precautions are taken with the latter, it is difficult to prevent the liberation of hydrogen, which has the drawback not only of being unfit to breathe, and so of taking up an important space in the atmosphere of the boat, but also of forming, with the oxygen of the air, an explosive mixture which is dangerous in the vicinity of an electromotor. This leads us to the question of the habitability of this closed microcosm, a question which is very simply solved by regulating the constant flow through a filter of the oxygenated air contained under pressure in the steel reservoirs, so that at each moment there is a supply sufficient for the lungs of the three occupants. The pressure in the hold is thus increased; but in order to restore the normal pressure, we have only to

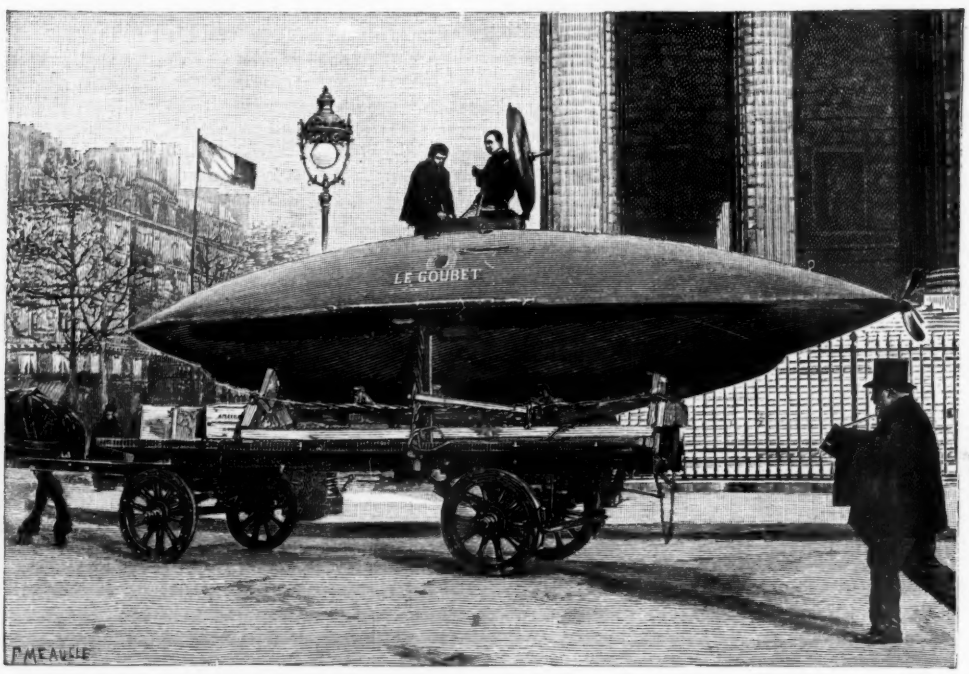


Fig. 3.

The point now is to remain submerged at the required level without appreciable variations. Now, the causes of these variations are not sudden; the disturbances of equilibrium are almost imperceptible, and in order to overcome them we only require to make very slight variations in the water ballast. A very ingenious regulating apparatus provides for this automatically; according to the circumstances of the case a pump draws up or sends out the water, the pulsations of which, so to speak, may be followed in a large glass cylinder. And the pump itself, worked by a small motor, is acted upon one way or the other automatically by the needle of the manometer, according as it strikes on the right or left of its regulating position, the two little contacts of a double electrical mechanism.

As we see in the *Goubet*, the vertical movements are independent of the horizontal ones; they can be produced when the vessel is at rest as well as when it is proceeding through the water, and is thus quite distinct from a large class of submarine boats, which, like the Whitehead torpedo boats, can only be sunk or raised when in motion, and can only be kept at the mean depth required by describing the undulations of a perpetual sinusoid, which is effected by means of horizontal rudders that cause a considerable loss of energy.

expel a corresponding quantity of vitiated air; this foul air, owing to its density, accumulates in the bottom of the boat, and is thence drawn up by the pump, and sent out into the sea. The excess of carbonic acid is absorbed by caustic potash, and that of organic effluvia by chloride of lime. Under these conditions the boat carries normally enough fresh air for a stay of 10 to 15 hours under water, which is more than sufficient, for its service will always be of limited duration; it will always be used in connection with the defence of a port, and when it has to be used in the open sea, it will be conveyed to the scene of action attached to an ironclad, its light weight rendering this quite practicable.

The principal combative work of a submarine boat consists either in carrying charges of explosives under the keels of the enemy's ships, or in throwing torpedoes from such a distance as to be safe itself from the effects of the explosion. With regard to this, it is worth while to note, by means of the regulating pendulum, the disturbance caused by the initial shock produced by the expulsion of the torpedoes of the Whitehead type from their socket or tube; the result of this shock is, that their course is an undulatory curve with

* The minimum fixed by the Ministerial specification was 4 knots.

variations of level sufficient to cause the torpedo to miss its destination. M. Goubet, struck with this fact, does away with this violent expulsion, and the torpedo is projected automatically and gently directly on its course. This is very simple, and should have been provided for before. The manipulation of the torpedoes may easily be managed by means of bolts passing through the sides. But the *external action* of the submarine boat does not stop here, although it is a closed vessel, and by means of levers of the same type other appliances can be manipulated: shears for cutting the cables or wires of the torpedoes, borers, instruments required for the sponge or coral fishery, or for bringing up wreckage.

The ambition of the inventor does not stop here; the present torpedo boat is the embryo of a submarine packet boat conveying passengers across the Channel or the Mediterranean, being hauled along a cable 15 metres under water. No more rolling, no more plunging. This is enough to make many travellers, subject to sea-sickness, pray for its success.—G. E.—(*La Nature.*)

## LOSS OF REVENUE DUE TO TRANSFORMER LEAKAGE CURRENT.*

By SPRING S. ARMSTRONG.

ALTERNATING current, as applied to electric lighting, has become nearly universal, and in a great measure the general excellence and efficiency of apparatus has kept pace with the increased demand, but, particularly in smaller central stations, it is a well-known and regrettable fact that too little attention has been given to transformers. It is a broad claim, but nevertheless a true one, that the transformer system of any alternating current station is the keystone of the arch on which profit and ultimate success are to be erected.

In view of the many strictly impartial laboratory and service tests made of the various transformers offered on the market, it is fair and reasonable to assume that two-thirds are a positive detriment to any plant, and that the sole reason for their existence lies in the ignorance of careless managers who accept claims made by manufacturers in blind confidence and without corroborative tests. It is unnecessary to explain that low first cost is the lever by which these inferior transformers have found their way to the confidence of central stations; and it is also worthy of note that the really good article, the distinctly earning factor purchased and installed by the larger and more intelligent plants, is always sold at a higher price than its unworthy brother.

There are transformers sold to-day in the open market at less than the actual shop cost of a high grade converter, and yet they are eagerly bought because they are "cheap," with careless indifference as to their future economy.

There are hundreds of plants throughout the country whose lines are crowded with small units of these "cheap" converters, each later purchase being a little "cheaper" than its predecessor, both in quality and in price. And yet the owners complain of their unprofitable investment but, nevertheless, they would not for a moment consider the expediency of "scrapping" these transformers and re-fitting their lines with economical devices, even though the change would result in a large increase of revenue.

From complete and impartial tests of all existing transformers in 1,000 watt sizes, it is seen that in more than two-thirds of different makes the leakage of current alone at no load is from 5 to 10 per cent. of the entire capacity of the converter, while in the remaining one-third it varies from $2\frac{1}{2}$ to $4\frac{1}{2}$ per cent. Taking the difference in extremes, a net loss of 75 watts may be charged to the account of the "cheap" transformer, from which the central station derives absolutely no revenue. Now, admitting that the small stations will run on an average of eight hours per day, we have, as a formula of dead loss, the following: $75 \times 8 \times 365 = 219{,}000$ watt hours constant loss per year on each and every one of these "cheap" 20-light converters. It is fair to assume that 60-watt 16 C.P. incandescent lamps will represent the average efficiency of lamps in use, for which $\frac{3}{4}$ ct. per lamp-hour is charged; hence, we have $75 \times 8 \times 365 - 60 \times \frac{3}{4} = \$27.38$ actual loss in revenue on *each* 20-light "cheap" transformer, or about 10 per cent. more than the first cost of the best of the high grade converters.

In a plant furnishing 1,000 lights, and employing on an average 20-light units of these inferior transformers, the loss of earning power due to leakage alone is \$550.00, or 5 per cent. interest on \$11,000.00. But it may be argued that this is not a fair estimate of the earning capacity of each transformer, due to the fact that all of this leakage would not be regularly paid for. This is very true, but we can only arrive at a just comparison by assuming this to be the case, for whether all of this loss by leakage is paid for or not, the conclusion holds good in the case of both the inferior transformer as well as the high grade one. However, judged alone by the coal pile, it is demonstrated that two tons of good coal per 1,000-watt converter are consumed annually to supply current for which not one penny is returned; *i.e.*, \$5.00 or \$6.00 annually, according to location of plant and price of coal, are required to pay the difference in leakage alone between the two types of transformers cited. This waste becomes more serious as plants increase in capacity, for it is, unfortunately, a fact that many stations with an output of several thousand lamps are using these inferior transformers by reason of their low first cost.

Now, let us consider this matter of first cost. A 1,000-watt converter (L) may be purchased in the open market for \$18.00. Another manufacturer (A) demands \$25.00, but L has a leakage of 100 watts, while A has only 25; hence to tabulate:—

| Type. | First cost. | Annual leakage in ampere hours. | Annual loss at $\frac{3}{4}$ c. per lamp hour. | Total cost at end of year. |
|---|---|---|---|---|
| L ... ... | \$18.00 | 4,867 | \$36.51 | \$54 51 |
| A ... ... | 25.00 | 1,217 | 9.12 | 34.12 |

Therefore A is honestly the cheaper of the two transformers, owing to lack of earning power of L by \$20.39.

This is not intended as an exhaustive treatise on transformers; therefore, avoiding comparisons that are not elements of constant loss, we will give only the demonstrated leakage on the *various makes of converters as given in a recent reliable test:*

LEAKAGE ON OPEN SECONDARY IN WATTS.

| A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | 34 | 42 | 43 | 48 | 51 | 60 | 61 | 77 | 84 | 89 | 108 |

All the manufacturers of transformers claim to have the "best," and as this is in the ordinary course of business, such claims are to be expected; but the central station manager is misguided and in error to blindly accept claims for facts, and allow a few dollars in first cost to jeopardise the success of his plant, under the grave delusion that one transformer is as good as another.

Many of the large and intelligently conducted stations are taking inferior converters from their lines, and deliberately selling them for junk, replacing them with the best transformers obtainable, and this only after a severe test of merit. With these stations it is noticeable that first cost plays but a minor part in selection, and is considered only where everything else is equal; it is the economy and revenue producing qualities that are sought for and purchased.

Equal care and intelligence will produce equal results in the small station, and if every manager will "scrap" *all* his leaky, cheap transformers, and purchase only a high grade article, he will make a saving the first year, even though he does not realise a dollar from the sale of his old converters. Furthermore, all manufacturers' claims should be set aside, and each transformer purchased should be thoroughly tested. For this purpose elaborate and expensive instruments are not necessarily required, fair results being obtainable otherwise. As bearing upon this subject, we quote from the admirable article, "The Choice of Transformers," by Prof. D. C. Jackson, which appeared in the issue of the *Electrical Engineer*, August 21st, 1895:

To test the iron losses, the secondary coil of a transformer should be connected to the regular lighting circuit, with an

* The New York *Electrical Engineer.*

ordinary wattmeter included, and the circuit of the primary coil should be left open. The reading of the wattmeter shows the number of watts which are wasted by the iron loss. A wattmeter, such as is required for these measurements, costs from $40.00 to $70.00, and is an instrument that, like the steam engine indicator, pays to have at hand for proper use. However, if the regular wattmeter is too expensive to buy, an ordinary Thomson recording wattmeter, provided a sufficiently sensitive and reliable one is at hand, may be used in place of it, and the record reduced to the basis of one hour. It is needless to say that instruments which are used in such tests as are here proposed must be fairly reliable. . . . . For guidance in selecting transformers, I will give the following data. . . . . The table gives the largest currents which should flow in the 1,000 volt primary of good transformers when the secondary circuits are open:

| Watts capacity. | Leakage current. |
|---|---|
| 1,000 | ·055 |
| 2,000 | ·080 |
| 6,500 | ·100 |
| 17,500 | ·200 |

. . . . . For intermediate capacities, intermediate values of the open circuit or leakage current may be expected. I shall add to this the values of the iron loss, which should not be exceeded in thoroughly good transformers:

| Watts capacity. | Iron loss. |
|---|---|
| 1,000 | 30 |
| 1,500 | 40 |
| 2,000 | 50 |
| 2,500 | 60 |
| 4,000 | 80 |
| 6,500 | 100 |
| 17,500 | 150 |

A careful perusal of Prof. Jackson's article in its entirety will amply repay any central station manager who is desirous of effecting a saving in his plant, and to determine the relative points of economy in his transformer system.

A very material saving may be obtained by the use of as large units in transformers as existing conditions will permit of. In small plants it is often observed that each residence is furnished with an individual converter, and later on, as customers are added in the same block, more small transformers are put in service, until in a block of, say, 10 houses, there will be seen as many small converters, giving 50 volts on the secondary, in use, one to each residence. Now, assuming that these 10 houses use in the aggregate 100 lights, great economy would result by removing the small units, and substituting, say, a 75-light transformer in some central location, and feeding into the various houses with 100 volts on the secondary.

In installing a 75-light transformer instead of a 100-light unit, it is justly assumed that all of the lights would not be in service simultaneously. Even should such an event occur, however, there would be no danger of a burn-out, as any high grade converter is guaranteed to safely carry an overload of from 25 to 50 per cent. of its rated capacity.

In making the changes suggested, the small units may be used advantageously in remote districts where there are not sufficient customers to justify for a time the installing of a large transformer. The gain effected by the proposed alteration would be about as follows:—

| | | |
|---|---|---|
| First cost of ten 10-lighters (est.) ... ... | $150.00 | |
| " " installing " ... ... | 25.00 | |
| Loss in leakage per year ... ... ... | 91.00 | |
| | | $266.00 |
| First cost of one 75-lighter (est.) ... ... | $65.00 | |
| " " installing " ... ... | 10.00 | |
| Loss in leakage per year ... ... ... | 26.00 | |
| | | $101.00 |
| Economy effected per year by using large unit | | 165.00 |

If managers will write to any of the manufacturers of reliable transformers, giving the conditions of their plant, and information as to where large converters may be substituted for several small ones, they will be furnished all data of savings that may be effected thereby. As a move in the direction of economy, *use the largest transformers possible in your service.*

While we have here touched upon only one of the many existing station losses and ventured upon suggesting a simple remedy, it may well be questioned whether our plant manager, to be consistent in all things, would not carry his inconsistencies so far as to purchase cheap boilers, engines, dynamos and lamps, buying all with no thought of future economy and for no other reason than that they were to be obtained at less cost than others in the market. To remedy existing transformer losses will, however, go far in the right direction and lead the way to such systematic overhaulings as may be necessary to put a small station on a solid base of profit.

This has not been written in behalf of any particular make of transformer, but is intended as a special plea to managers of alternating current plants, to look beyond the immediate future for economies to be effected and consequent profits to follow. Plants which are operating lucratively are an attractive and effective inducement for further investment of capital, thereby benefiting electrical industries as a whole.

## GASEOUS FUELS.

Mr. H. L. Gantt has gathered some useful figures concerning gaseous fuels, and embodies them in an article in *Cassier's Magazine*. In the manufacture of producer gas, as is now termed the peculiar product of the Wilson, Dawson, Thwaite, or other form of apparatus, which the French have agreed to name "poor gas," the formation of carbonic oxide disposes of, or sets free about 30 per cent. of the heat of combustion of carbon, leaving only 70 per cent. to be utilised, excepting, of course, where the gas can be used hot. Hence, if used at a distance, some endeavour should be made to send the gas away from the producer at as low a temperature as possible, so as to avoid loss by radiation. An aid to this end is the fact that incandescent carbon will decompose water, the oxygen going to form the carbonic oxide, and the hydrogen being set free. The decomposition requires heat, and in this way what would have been sensible heat without steam becomes latent heat when steam is injected with the air into the producer. Actually, however, producer gas contains a good deal of inert gas, to wit, the nitrogen of the air used, and carbonic acid, which it has so far been impossible to altogether avoid making. Thus, as air contains only 23 per cent. of oxygen by weight, 1 lb. of carbon burned to monoxide uses 1·33 lb. of oxygen, and carries 4·46 lbs. of nitrogen, forming 2·33 lbs. of monoxide, a total weight of 6·79 lbs., whereas if burned to dioxide the total weight of mixed gases will be 12·594 lbs.

The following calorific powers will be useful. The heat developed is given in British thermal units.

| Gas. | B. T. U. Per pound | B. T. U. Per cubic foot. |
|---|---|---|
| C to CO ... ... ... ... | 4,400 | ... |
| C to $CO_2$ ... ... ... | 14,500 | ... |
| CO to $CO_2$ ... ... ... | 4,325 | 319 |
| H to $H_2O$ ... ... ... | 62,000 | 327 |
| $CH_4$ to $CO_2$ and $H_2O$ ... ... | 23,500 | 1,007 |
| $C_2H_2$ to $CO_2$ and $H_2O$ ... | 21,400 | 1,593 |

The heat is calculated on the assumption of initial and final temperatures of 62° F.

The number of cubic feet per pound of different gases will be useful.

| | |
|---|---|
| Air ... ... ... ... | 13·14 |
| Nitrogen ... ... ... ... | 13·50 |
| Oxygen ... ... ... ... | 11·88 |
| Hydrogen ... ... ... ... | 189 79 |
| Carbonic Oxide ... ... ... | 13·55 |
| Carbon dioxide ... ... ... | 8 60 |
| Marsh gas ... ... ... ... | 23·32 |

Necessarily, producer gas varies with the kind of coal employed, and practice will give the yield of the undesirable dioxide between 2 and 8 per cent., the former figure being exceedingly good practice, the latter not to be tolerated while 4 per cent. is good ordinary work. The best result accompanies cold and slow working; but a high percentage may be produced, not merely by the reverse of this, but by uneven firing, and the burning of the fuel mass into holes. A producer should be kept well poked down to consolidate the fuel as it wastes away. Assuming the gas to be cooled before use, a number of tables have been prepared for dif-

ferent fuels, showing the working of a producer with anthracite coal containing 10 per cent. of ash, and 5 per cent. of volatile hydro-carbons (practically $CH_4$, or marsh gas), the gas produced having 3·7 per cent. of carbon dioxide. The tables give the product of 1 lb. of the fuel in weight of gas produced, cubic feet, heating capacity, heating capacity per pound and per cubic foot, the final column being the efficiency of conversion or ratio of available heat in the cooled product to the total heat of the solid fuel.

| Coal. | Lb. of gas. | Cubic feet, gas. | B.T.U. | B.T.U. per lb. | B.T.U. per cb. ft. | Efficiency. | |
|---|---|---|---|---|---|---|---|
| 1 | 6·411 | 85·331 | 8,743·75 | 1,363·9 | 102·5 | 64·77 | No steam used. |
| 1 | 5·148 | 75·80 | 11,573·04 | 2,248 | 152·7 | 86·00 | Steam blown, good practice. |
| 1 | 5·379 | 78·415 | 11,223·75 | 2,086 | 143·1 | 83·14 | Steam blown, normal practice. |
| 1 | 5·624 | 81·14 | 10,816·92 | 1,923 | 133·3 | 80·00 | Steam blown, poor practice. |
| 1 | 4·522 | 62·81 | 11,144·6 | 2,464·5 | 177·4 | 77·53 | Bituminous coal. No steam. |
| 1 | 3·94 | 59·34 | 12,615·25 | 3,201·8 | 212·6 | 87·8 | Steam blown, bituminous coal, normal practice. |

The steam is supposed to yield one-fourth of the oxygen in those cases where it is used. The good and poor results with bituminous fuel show efficiency of 90 per cent. and 85 per cent. respectively.

The analysis of the gases produced shows, without steam, 27·79 and 23·67 per cent. of CO from anthracite and bituminous coal respectively, while for steam blown producers the normal averages are 30·24 and 24·0. The same four figures of $CO_2$ are 3·70, 4·01, 4·02, 5·3, and the percentage of this gas may be taken as the index of the quality. The figures for bituminous coal presuppose a fuel containing 55 per cent. carbon, and 32 per cent. of hydro-carbons. If used hot, the efficiency of the non-steam blown gas will be very high; but if cooled, a good deal is lost as tar. There is no such loss by cooling of the gas from anthracite, but the efficiency calculated for bituminous fuels will always be reduced below the tabular percentage by the condensation of the hydro-carbon. For a Siemens steel melting furnace, however, a rich gas is essential, if the required temperatures are to be obtained. The loss in gas with too much $CO_2$ comes in not altogether in the producer, but in the large extra amount of nitrogen that a surplus of $CO_2$ involves, so that no matter how much of the gas be used, a too poor gas becomes entirely inadequate to its duty by reason of the dilution of temperature involved.

In the Siemens producer—the oldest form—there is no steam, but merely natural draught produced by large cooling conveyer tubes used to promote the working, and this causes a good deal of loss in what is obviously a hot-gas producer. Still, though crude, it was a success. Close the ash-pit and put on steam, and at once the producer is improved, and all these producers, as modified by Swindell and Bros., of Philadelphia, and others, have a cinder grate, that is, one covered with a bed of the soft cinder, which is the product of a steam blown, and therefore cool, non-clinker forming fire.

The Smythe producer has a large inclined grate and a water-sealed hearth pit. The Taylor producer has no grate, but has a circular plate which carries a thick cinder bed, and air is carried in with steam at the middle of the plate, an arrangement which avoids the risk of air blowing wastefully up the walls. By revolving the plate, the cinders on it are ground up, and the cinders fall out over its edge, the arrangement being that of a pipe feeding loose material, which only flows when the supporting mass is moved. The rate of revolution of the plate, or if actuated as shown by hand, the judgment of the user must determine the amount of clearing of the grate. Many of these producers are being run on the smallest grades of coal, but the author is of opinion that satisfactory mechanical stokers have stopped further progress. There is, however, a boiler plant running very satisfactorily on producer gas at Camden, N.J., at the works of R. D. Wood & Co. Taylor producers are used. The gas was cooled from 600° to 300° in its passage to the boiler, by reason of water flowing in the buried conduits. Two producers were used, one being water-jacketed and used as a feed heater, the feed being thus heated to 298°. Anthracite buckwheat coal, with 25 per cent. dirt, was used, and the gas produced contained 4 per cent. of $CO_2$. The air supply to the boilers was heated to 200° by passing through ducts in the setting, and the chimney was at 415°. The steam blower absorbed 6·66 per cent. of the steam produced, and the chimney gases contained 1 per cent. of CO, and 13·7 of $CO_2$. The results were as follows :—

| | |
|---|---|
| Water evaporated per pound of fuel ... ... | 7 lbs. |
| Water evaporated per pound combustible ... | 8·7 lbs. |
| Ditto, from and at 212° ... ... ... ... | 10·5 lbs. |
| H.P. when direct fired ... ... ... ... | 65 lbs. |
| H.P. when gas fired ... ... ... ... | 91 lbs. |

The latter figures are particularly interesting. Why the increase in the duty of the boiler by 40 per cent.? This the author attributes to the keeping clear of the boiler tubes by dust, and the fact of the doors not being opened to admit air over the boiler. The result seems good, and much better than others we have heard of.

Referring to the use of producer gas in engines, the author refers to a record of two tests. One was with a 100 H.P. engine at the Otto gas engine works in Philadelphia, the other of a similar engine at Danbury. As the air blast from a Root blower was made to take up steam from water heated by the produced gas in the scrubbers, there was no steam required other than that so produced, the air taking up all that was necessary from the hot water. The figures are as follows for the composition of the gas :—

| Gas. | By volume. | By weight. |
|---|---|---|
| CO ... ... | 25·38 ... ... | 26·08 |
| H ... ... | 4·51 ... ... | 0·33 |
| $CH_4$ ... ... | 1·79 ... ... | 1·05 |
| O ... ... | 0·26 ... ... | 0·23 |
| $CO_2$ ... ... | 4·02 ... ... | 6·50 |
| N ... ... | 64·04 ... ... | 65·81 |

The composition of the exhaust gas was as follows :—

| | | |
|---|---|---|
| $CO_2$ ... ... | 15·60 ... ... | 22·44 |
| O ... ... | 2·24 ... ... | 2·34 |
| CO ... ... | 0·23 ... ... | 0·22 |
| N ... ... | 81·93 ... ... | 75·00 |

And the results are summarised thus :—

| | |
|---|---|
| Coal per I.H.P. hour ... ... ... | 0·9511 lb. |
| Coal per B.H.P. hour ... ... ... | 1·315 lb. |
| Combustible per I.H.P. hour ... | 0·8302 lb. |
| Combustible per B.H.P. hour ... | 1·148 lb. |

the actual horse-power being only 72 per cent. of the indicated, which is attributed partially to newness of engine. In the Danbury test this figure was 87 per cent. On this basis the coal would be 1·09 and 0·95 respectively, and this affords one more confirmation of the superior efficiency of gas engines so soon as they are accepted as mechanically sufficient. The question of cost must, however, be considered. Our author does this, and concludes that for small powers the cost of producer with necessary holder, scrubbers, blower, and engine is large, compared with that of engine and boiler, and the question resolves itself into equating the cost of the plant with the cost of working same. With large powers, however, the gas plant compares much more favourably, seeing that the expensive holder need be no larger for 1,000 H.P. than for 100 H.P., and somewhere between these two powers the plant cost will be the same for steam or for gas, and above this point all will be in favour of gas both in cost and working. In the future we may take it that small power plants will be abolished, to be replaced by plants of large power with gas engines, producers, and a system of electrical distribution of power, which will cost the small user less than it now costs him to run his small steam plant or gas engine, and will save him a good deal in shafting and the usual accessories of the millwright. We have in mind as we write, a workshop measuring about 120 feet × 50 feet, where a gas engine drives a line shaft of 100 feet in length, and does this chiefly for the purpose of working a small smithy fan and one lathe, and occasionally a drilling machine. The chief work is the revolving of the long shaft, which goes on all day, irrespective of whether the smith or the turner is needing power. An electric motor to each machine, especially that upon the smithy fan, would run but a very short time daily, and consume a mere fraction of the power now running to waste all day.

## THE CABLE REPAIR STEAMER "MACKAY-BENNETT."*

The present is peculiarly a scientific age, rife with great enterprises which have originated within the memory of most people. It is not a great many years ago when the completion of the first ocean telegraph was celebrated with great pomp and enthusiasm. Transoceanic telegraphy is distinctively a modern institution; as such it is necessarily controlled by modern methods.

One of the great companies, the Commercial Cable Company, owns and operates three complete submarine lines between Europe and the United States. To keep these cables in order this enterprising company has a fine steamer, the *Mackay-Bennett*, which was built especially for the purpose by John Elder & Co., at Govan-on-the-Clyde, at a cost of $320,000. She is 260 feet long, 40 feet beam, and 22 feet deep, and is propelled by twin screws driven by independent compound engines, each having a high pressure cylinder 15 inches in diameter, and a low pressure cylinder 25 inches in diameter, the stroke being 3 feet. The combined horse-power of the engines is 1,500. The gross tonnage of the vessel is 1,700, and the coal capacity is 750 tons. Her speed is 12 knots per hour.

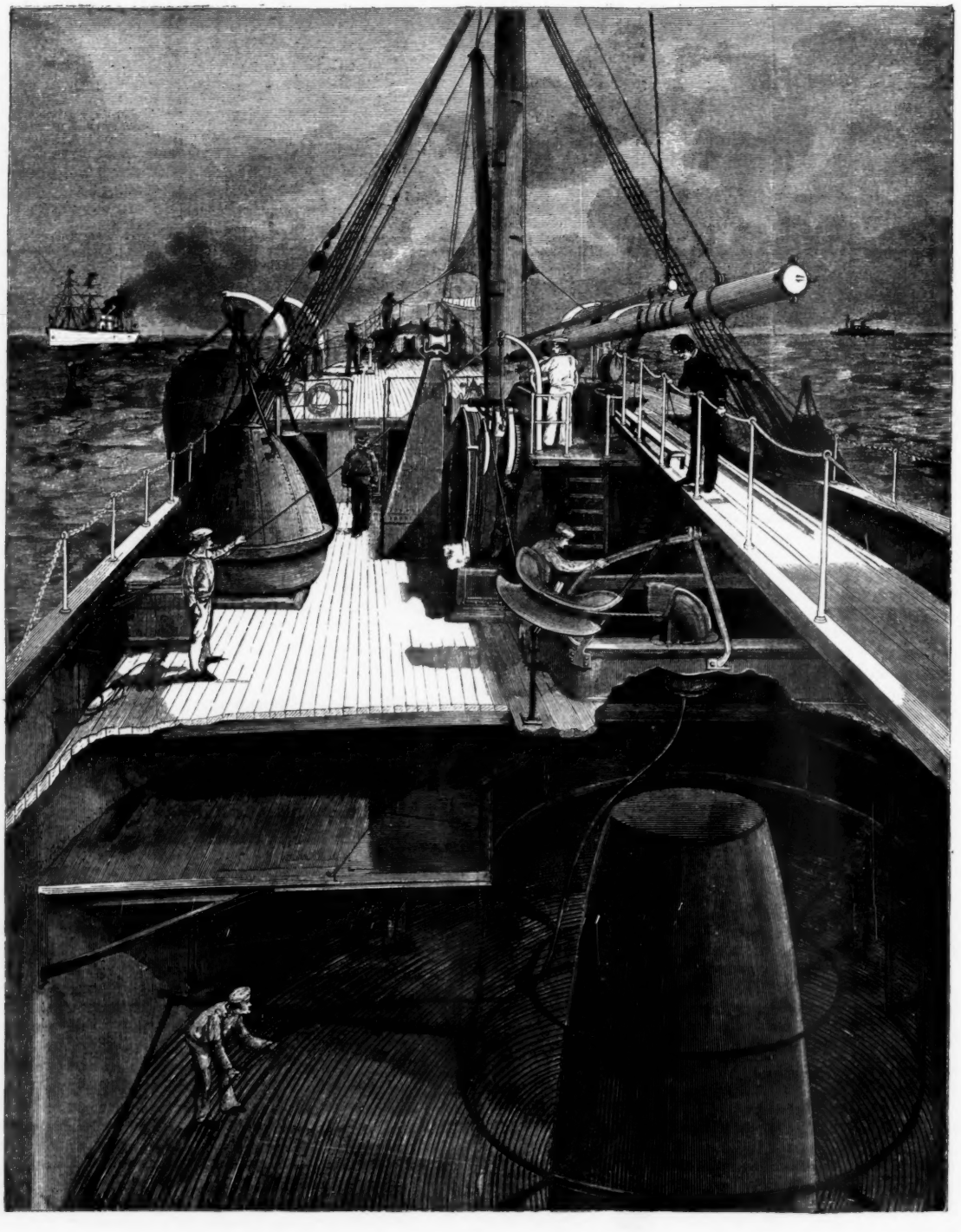

Fig. 1.

The *Mackay-Bennett* is provided with three cable-holding tanks with a total capacity of 385 nautical miles; tank 1 holding 60 miles; 2, 195 miles; and 3, 130 miles. The central cones around which the cable is coiled are utilised as

* *Scientific American.*

fresh water tanks. The steamer is fitted up with all the modern machinery for grappling, picking up, and paying out cable. It is lighted throughout by electricity, and is furnished with electric search lights, so that work can be carried on during the night. The steering is done by steam, and the necessary steadiness is secured by bilge keels. The vessel is provided with a bow rudder, so that it can steam astern. The manœuvreing qualities are excellent. A staunch steam launch is provided, which is much used in work near the shore.

On the deck are placed two powerful engines for heaving in and paying out the cable. At the bow and stern are

On the upper deck, at the bow and stern, are electrical signals, by means of which the engineer in charge of the ship's engine, and also the engineer in charge of the cable handling engines, may be notified to stop, start, or go ahead or astern, fast or slow, as circumstances may require. Attached to the shaft of the drum is an indicator which shows the number of miles of cables paid out or taken in. On the deck of the steamer are guides, which lead to the different tanks. The cable may be drawn from either of the three tanks by either of the cable-handling engines. Upon the deck are carried buoys, which are launched, and to which

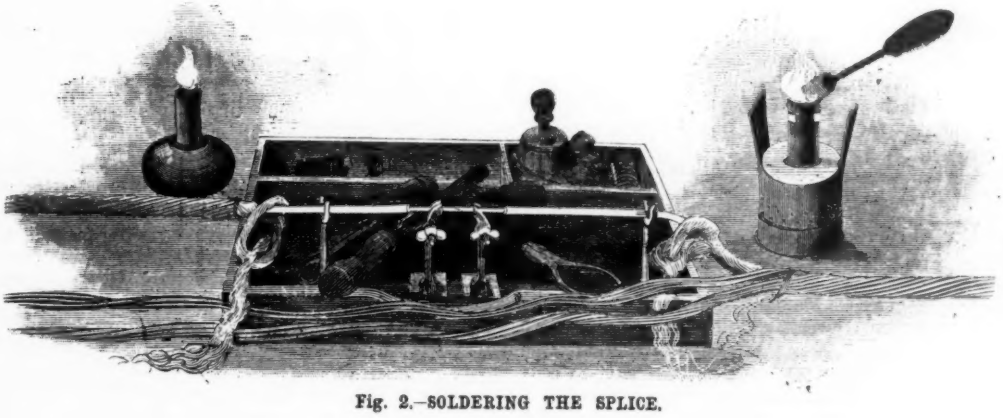

Fig. 2.—SOLDERING THE SPLICE.

placed immense sheaves, over which the cables pass when delivered or received. The engines for handling the cable are geared to drums 6 feet in diameter, 2 feet in width, each being mounted on a shaft 11 inches in diameter. The cable, which is wound several times around this drum, passes over quadrants or guides at the hatches. If it is being taken up, it is coiled in the tank

the cable is secured when it is desired to detach the cable from the steamer, and leave it to be subsequently picked up and extended. The cable tanks are water-tight, and the cable is kept in water, and while the laying of the cable is going on, electrical tests are progressing continuously, so that any defect may be detected and remedied before the cable reaches its final resting place upon the ocean bottom, the

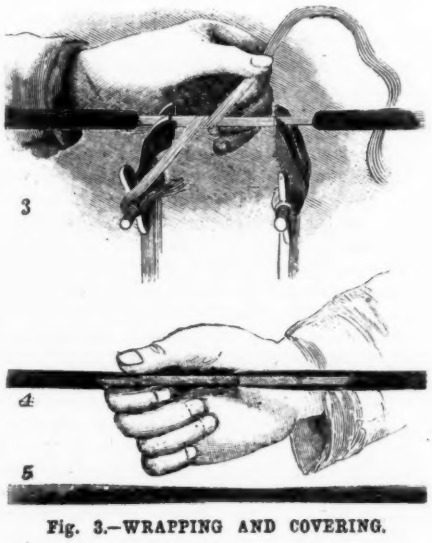


Fig. 3.—WRAPPING AND COVERING.

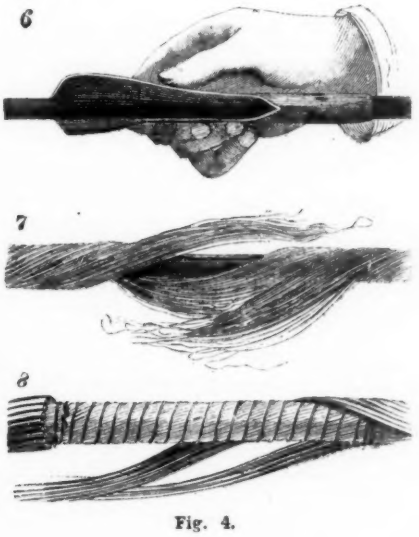


Fig. 4.

below, as shown in the large engraving. In this case it requires a powerful engine to bring it up from the depths of the ocean, but where the cable is paid out, it simply passes over the drum, which is then detached from the engines, and the paying out is controlled by a brake operated by the man on the platform. The cable in its passage to the bow or stern of the steamer goes under the sheave of the dynamometer, which indicates the amount of tension on the cable. The strain on the cable usually ranges from two to three tons.

electrical testing room has a very complete electrical equipment, and the electrician is always in attendance to discover and locate any faults.

To one not familiar with the characteristics of the electric current, it seems a difficult matter to locate a fault in an ocean cable hundreds of miles at sea, but a competent electrician can generally locate the fault within a few miles. The insulation of the conductor must be maintained in a very perfect condition; otherwise the cable is rendered useless. A puncture in the insulation of the diameter of a hair is suffi-

cient to interfere with the proper working of the cable, and to necessitate the journey of the repair steamer to the point where such an apparently insignificant thing exists. On reaching the vicinity of the fault the grapnels are thrown out and the cable lifted to the steamer, when it is taken on board, and dissected and repaired, the defective section being removed and replaced by a perfect piece of cable. The manner in which the cable is spliced is illustrated in fig. 2. After the defective portion is cut out, the ends of the cable adjoining the splice are unwound, and the copper conductor at the centre is laid bare. The ends of the copper conductor are scarfed and lapped, as shown; then the joint is secured by soft solder, after which a spiral wrapping of fine copper wire is laid over the joint, as shown at 3 in fig. 3, four or five fine wires being laid on parallel with each other, forming a spiral wrapping of considerable pitch. Upon the first layer of fine wires another layer is placed which is wound in the opposite direction, thereby causing the wires to cross each other. These wires are soldered smoothly, the interstices being completely filled with the solder, and while the conductor still retains the heat acquired in soldering the gutta-percha covering is worked over the joint, as shown at 4 in fig. 3, the splice having been previously coated with a cement to insure the perfect adhesion of the gutta-percha to the metal. The appearance of the cable core after the completion of this step in the process is shown at 5 in fig. 3. A wrapping of gutta-percha is now placed on the joint, as shown at 6 in fig. 4, this part of the work being done with the greatest of care, to avoid the slightest possible air space communicating with the conductor. The gutta-percha covered conductor is served with marline, 7, fig. 4, and this is wrapped with fine twine, as shown at 8 in fig. 4, and last of all, the wire armour is replaced. The total length of the splice is from 40 to 80 feet. The operation of splicing the armour is practically the same as that of splicing any wire cable. The splice thus made is stronger than the cable, and its electrical conductivity is also greater than that of the other parts of the cable. The *Mackay-Bennett* can lay cable at the rate of six to eight miles per hour.

It is obvious that in laying cable it is necessary to know something of the character of the ocean bottom. It is especially desirable to avoid shallow places. The steamer is provided with the James "sentry and sounding machine," which gives notice on board of the approach to shoal waters. [This has been fully described and criticised in previous numbers of the Electrical Review.] A device called a "kite" is trailed behind the steamer, being attached to the end of a piano wire wound upon the drum of the sounding machine. The kite is attached to the wire in such a manner that it dives under the stern of the boat to the minimum depth.

Should the steamer enter shallow water, the lever at the lower end of the kite strikes the bottom and releases the front end of the kite, so that it trails behind the steamer at, or near, the surface, and offers less resistance at the machine.

The diminished pull causes a bell to ring on the sounding machine and another on the bridge. The sounding machine is adjustable for different depths. On the deck, at suitable places, are placed electric signalling machines, made by Eliott Bros., of London, for communicating with the engineer of the paying-out machines, and with the ship's engineer. The *Mackay-Bennett* came on from Halifax, in September last, to lay cable for reporting the yacht race. The shore end of the cable was dropped at Coney Island, at a point east of the Oriental Hotel. From this point it was laid out to the lightship, and an extra mile was run out in great coils to enable the ship to change her position if necessary. By the use of this cable, reports of the movements of the yachts were instantly transmitted to New York city, so that the progress of the race was better known to observers of the bulletins than to most of the actual spectators. Through the courtesy of Captain E. G. Schenk, chief officer; W. F. Linton, engineer; J. W. Burn, and the electrician, C. Priest, we were enabled to thoroughly inspect everything on board the steamer.

The *Scientific American* has omitted to mention that the *Mackay-Bennett* was built under the direction of Messrs. Siemens Bros., and fitted out with cable gear, &c., by them. Indeed, for some time the ship was managed by their engineers, Messrs. Brittle and Doerner.

## "PAST AND PRESENT OBSTACLES IN THE STORAGE BATTERY DEVELOPMENT."

By L. EPSTEIN.

It is evident that Mr. Carl Hering, the author of this paper,* has given much time and thorough attention to the solution of the question how to construct a good accumulator; but many of the hints thrown out, and recommendations made by him, have been anticipated and removed from the field of speculation to the more substantial basis of actual working. In fact, most of the desiderata recommended by him will be found embodied in the accumulators of which the writer of this article is the inventor, and which have now been on the market for several years.

The missionary work which, according to the above-named paper, must first obtain before public confidence will be restored, may apply to the United States; but in this country we can look back with satisfaction upon the missionary work done many years ago, being now in the fortunate position of reaping the results. There exists at the present moment no doubt in the minds of consulting and central station engineers that an improved Planté type is far superior to any type in which the material is employed as a paste or as a conglomerate.

The "delicate sickly baby" has, in this country at least, long since developed into a strong and healthy youth, promising ere long to attain full maturity, and we may hope to preserve it during a reasonably long lifetime.

The five chief diseases of an accumulator are enumerated as follows:—

1. Buckling.
2. Short-circuiting.
3. Sulphating.
4 and 5. Disintegration and dropping out of peroxide.

I quite agree with the author of the paper that it is impossible to prevent buckling by sheer force. This has been attempted over and over again, but has never met with complete success. The only certain way to obviate buckling is to construct the plate in such a manner that it will not occur. The causes of buckling are manifold, the two chief ones being, apart from short circuits, unequal action of either the active material or the supporting grid or frame. In a plate either pasted, or otherwise so constructed that the active parts form comparatively large units as compared with the conducting parts, there will, and must always be, an unequal action, not only of the different slabs contained in one plate, but even of the different parts in one and the same slab. Some will contribute more to the discharge than others, and as a natural consequence, at the end of the useful discharge, not two slabs, nor two parts of one and the same slab will be found in the same electrical and chemical condition. Furthermore, as it is impossible to construct a grid thoroughly uniform, some ribs being originally thinner, or become more peroxidised than others, there will be an unequal flow of electricity in different parts of the grid. Bearing in mind the expansion and contraction consequent upon different stages of charge and discharge, it will become evident at once that, owing to the different density and expansion of the material, something will have to give way, and if it is not the material, it will have to be the frame.

"The ideal method would seem to be a vertical lead plate to act as a good conductor, with an extremely large surface and a thin layer of peroxide on it, thoroughly exposed to a large quantity of acid which is capable of circulating rapidly." This identical method suggested itself to the writer of this article more than five years ago, at which time he could already look back upon ten years' work and experience in accumulators, assisted by most efficient technical and financial support. His plate, as used in hundreds of installations for all the different purposes to which accumulators are applied, have invariably met with the most complete success, and sometimes under conditions which were very exceptional and most severe. The Epstein plate consists of a vertical web, with an equal number of horizontal ribs

* See page 58 of this number.

on both sides, and the active material is produced out of the substance of the lead itself by chemical and electrical processes without any material being applied to the plate. The active material blends gradually with the original substance of the lead itself, ensuring the most perfect contact. Examined under a magnifying glass, it becomes apparent that the active material not only covers the surface, but enters into the plate by a myriad of minute roots. The grooves are not completely filled out, and as the ribs are so constructed that the surface of the plate is increased fivefold, it will at once become apparent that the Epstein plate realises the anticipations of Mr. Hering with regard to good conductivity, large surface, and a thin layer of peroxide on it.

It has been proved by numerous tests that this plate withstands a treatment that has been found destructive to other types. I refer to tests made by Prof. Ayrton, in which such plates were discharged down to zero, and allowed to rest for considerable periods both after charge and discharge; also to tests made by Messrs. Alabaster, Gatehouse & Co., in which the cells, after standing idle for three months without intermediate charge, were found to have retained 80 per cent. of their original capacity; further, to the tests of Mr. Henry Lea, in which he habitually short-circuited Epstein cells for months by means of a stout copper wire, and many other similar tests and practical experiences, all giving the same result. It was to be expected that the capacity of such a plate could be utilised to much greater advantage than that of a plate in which the active material is present in a more or less thick layer, the surface of the corrugated plate being everywhere freely exposed to the acid. This was fully borne out by the test made by Mr. Swinburne. In his report he lays stress upon the extraordinary constancy of pressure. He expresses himself as follows: "Not the least merit of the Epstein cell is the extraordinary constancy of pressure throughout most of the discharge. When discharged at a normal current, the pressure keeps almost absolutely constant until the cell is entirely discharged."

It is not surprising that the much dreaded formation of an undue amount of sulphate should be absent in this type of plate, as the active material, instead of being present in a comparatively small number of large units, is distributed all over the plate in units which only form a small fraction of one of the former. The active and conducting parts, which can in the pasted plate only work harmoniously if a kind of compromise is arrived at between their divergent interests, work in this plate harmoniously together, and during the different stages of charge and discharge, by reason of a reciprocal give and take, their interests are identical, and they do not tend to part company if one of them is favoured at the expense of the other. The assertion that the gradual washing away of the surface of the peroxide, and the slow peroxidisation and consequent disintegration of the lead support seem to be absolutely unavoidable is, in the main, correct, the remaining question being only that these two sources of decay should be sufficiently slow as not to militate against technical usefulness and the financial success of the battery. In the Epstein plate, both these influences, although they may be at work, make themselves only very gradually felt. For instance, plates which have been in daily use for two years in a central station were found on examination to look like new, and, on test, to have retained their full original capacity. Mr. Hering's opinion that the only batteries which have an outlook for traction work are those which have a very large surface, very small depth of active material formed electrolytically, can be fully endorsed; while, on the other hand, exception must be taken to the remedy suggested for retaining the effectiveness of the positive plates, consisting in making the frames very thin, and replacing them from time to time, it not being possible to retain the active material in them. This method would only recommend itself as an alternative, but inasmuch as the positive plates of the Epstein type have made on a very trying road more than 12,000 car miles, without any repairs or renewals becoming necessary, it is clear that they are eminently fitted for the work.

In many cases it will be found more advantageous to provide in the car light batteries of small capacity for a few trips in preference to heavier batteries for a greater number of trips. In such cases it will of course, be indispensable that the small battery should be capable of discharging at high rates. The type manufactured by the Epstein Company for traction purposes, allows being discharged with a fairly good efficiency in one hour, and even less, and thereby enables a very considerable reduction in the weight to be made. The increase in the total weight of an accumulator car with full complement of passengers, as compared with a car driven on the trolley system, need not be more than 3 per cent. Astonishing as this figure may be found, full proof for its correctness can be adduced.

On the basis of the results which have been enumerated in the foregoing, the writer hopes not to be considered presumptuous if he suggests that a more fitting heading for an article dealing with the present aspect of storage batteries would be "Past Obstacles and Present Successes."

## THE MERCHANDISE MARKS ACT.

A CORRESPONDENT writes:—The fairness which characterises the article entitled "Made in Germany" in your issue of December 27th, encourages me to send you a few remarks on the subject of the Merchandise Marks Act. This Act was designed to prevent the fraudulent use of trade marks, not only on goods of foreign manufacture but also of home make. It may be described as an Act intended to prevent the making of a commercial profit on a reputation acquired by others. To meet certain prominent cases in which the trade marks of British manufacturers were infringed, or colourably imitated, by foreign makers, it was wisely decided to lock the stable door before the horse was stolen, or in other words, to prevent the importation into the United Kingdom of goods bearing the name or trade mark of any manufacturer, dealer, or trader, in the United Kingdom, unless such name or trade mark were accompanied by a definite indication of the country in which the goods were made or produced. Such a provision may be described as quite in accordance with the underlying motive of the Act—the repression of the false. This was no reflection on foreign goods or their makers. There is no necessity to place the name of any country of origin upon goods which bear no trade mark or name, yet it is by no means unusual to find such goods branded with the phrase, "Made in Germany." If you purchase at an English holiday resort a toy mug bearing the legend, "A present from (say) Margate for a good boy," it will probably bear the additional words "Made in Germany." Although Margate is not renowned for its pottery works the inscription would imply that it originated in the Isle of Thanet, and the customs authorities, carrying out the intention of the Act in discouraging the false, would be correct in preventing the importation unless qualified with the name of the place of origin. A similar mug made in Lambeth or Staffordshire need bear no qualifying words, and if any purchaser really thought or cared that the mug originated in Margate, the false representation would pass unchecked. I have a clock which is a marvel of cheapness, and of a kind which is certainly not a staple English manufacture. It bears the legend "Made in Germany," but a perusal of the Act does not show why it should. It bears English words, such as "fast" and "slow," for the convenience of the English purchaser. The other inscription may be placed there by the German maker from pride in the manufactures of the Fatherland, or because the Customs Authorities, who have wide powers under the Act, interpret the English words as an indication of English origin. I do not doubt that the Customs regulations are responsible for the frequent appearance of the place of origin—that being the easiest way of avoiding difficulties. Thus we see it more often than we need, and some amongst us are desirous of taking every opportunity of appealing to our national pride and utilising an Act designed to

protect English marks into an instalment of protection of English manufactures. The high and dry protectionist would undoubtedly approve such results, but those who realise that England is a commercial nation as well as a manufacturing one, may well fear that the Merchandise Marks Act extended beyond its original intention, will eventually be found to be detrimental to our best interests. British manufactures were not built up by appeals to "support home industries," and they will not be sustained thereby.

To return, however, to the point of more particular interest to electrical manufacturers:—Such a case as that mentioned by you seems to be entirely outside any question of place of manufacture. Patents protect brains, the Merchandise Marks Act protects trade reputations. If patents are infringed the remedy is in the patentees' hands; if a false mark or trade description is applied to the goods, correction may be administered even more summarily. Before we complain of German imitations of unpatented or unmarked articles, we ought to be satisfied that we are free from reproach ourselves. It is not customary amongst English manufacturers of the better class to utilise other's brains and make absolute copies of others goods—but it is done, and there is no remedy. It is not customary amongst the better class of German manufacturers to make absolute copies of English patterns. If they do, and the goods are unpatented and unmarked, there is no legal ground of complaint. Before we begin to complain on moral grounds we ought to be sure that we have attained to a higher morality ourselves. The complaint of foreign competition is too often a wail of weakness, or a cover for bad management, and the appeal to local prejudices is a game that may be played from two sides. It is not uncommon to hear "British interests" talked about in foreign accents, and it should be remembered that the Merchandise Marks Act is a broken reed for unmarked goods. What is needed in the electrical business at the present day is that more attention should be paid to quality, and the place of origin disregarded. If we attempt any other discrimination than quality and price we shall inevitably get behind.

We have certain markets even in protected countries, because of the superior quality of our manufactures. Reliance on protection in any form other than the protection of brains is certain to lead to a carelessness which will tell in time, until, perhaps, "made in Germany," far from being a reproach, may become a recommendation. The Merchandise Marks Act has probably done considerable injury to our shipping and carrying trade. If the effort to extend it beyond its legitimate intention, and to develop a Chauvinistic tendency through its means should continue, it will inevitably do harm to our manufacturing trades also. But the ultimate evil is more indefinite than the present advantage, and the injury to the body politic is less observed than the personal gain. That is the evil of protection in all forms. A word of warning is needed, though there is little hope of its being heeded. Undoubtedly the protectionist tendencies of other countries is responsible for a great deal of the feeling on the subject, but our policy, if it is to be revised at all, should be plain and direct. Let us place a duty on foreign made lamp holders and double-pole cut-outs by all means—if we decide that protection is desirable—but do not let us attempt the indirect and indefinite protection of placing restrictions on trade.

**The Electromotive Force of Certain Standard Cells.**—At a recent meeting of the Paris Academy of Science, Mons. Linet presented a paper in which he had recorded some measurements of the electromotive force of the Clark, Gouy, and Daniell standard cells. The Daniell cell was of the Fleming type. The methods of experiment do not call for any special remark. As the result of a considerable number of measurements, the following values were arrived at, namely:—

| | |
|---|---|
| Latimer Clark ... ... ... | 1·4535 volts. |
| Gouy ... ... ... ... ... | 1·3928 " |
| Daniell (Fleming type) ... ... | 1·0943 " |

The above measurements were all made at a constant temperature of 0° Centigrade. The original paper may be found in the *Comptes Rendus*, Vol. cxxi, pp. 199—200.

## TESTS OF A 10-HORSE-POWER DE LAVAL STEAM TURBINE.*

By WILLIAM F. M. GOSS, Lafayette, Ind.

The de Laval steam turbine experimented upon constitutes a part of the permanent equipment of the engineering laboratory of Purdue University, and the present paper is based upon data secured chiefly through the assistance of Charles E. Bruff, B.M.E.†

### I.—Description of the Engine.

In the de Laval steam turbine, jets of steam, delivered from suitable nozzles, are made to impinge against the buckets of a light turbine wheel. The steam enters the buckets from one side of the wheel, and passing through, is discharged or "exhausted" from the opposite side. The arrangement of nozzle and wheel is shown by fig. 1. The motion of the turbine shaft, which, under the action of the jets is extremely rapid, is communicated by gearing to a heavier and slower-moving driving shaft carrying a fly-wheel of small diameter; from this wheel the power of the engine is delivered. Regulation of speed is secured by means of a throttling governor, which controls the pressure of the steam admitted to the nozzles.

The important moving parts, with approximate dimensions, are shown by fig. 2. The turbine wheel is built up of 63 steel segments, each carrying a bucket and a portion of the light outside rim. The segments are held in place by means of suitable collars, which grip them on either side. The wheel is mounted upon a long, slender shaft, having sufficient flexibility to allow the system at speed to revolve about its centre of gravity, even though this may not agree with the geometrical axis of the shaft. The gear upon the turbine shaft is of steel, solid with the shaft; that upon the drive shaft has its teeth formed in a bronze ring, which is carried by a solid iron centre. The smaller gear has 21 teeth, the larger one 208 teeth, giving a ratio of 1 to 9·90476.

The shafts run in bronze boxes completely lined with babbit or

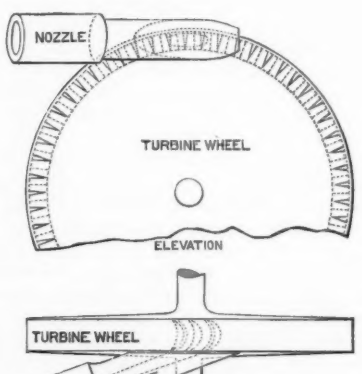


Fig. 1.

other soft metal. To assist in the distribution of oil, a spiral curve, the pitch of which is about half the diameter of the journal, is cut into the metal of the bearing. The outboard bearing on the turbine shaft is closed at the end, and a small pipe runs from the closed end to a point over the gears. The pumping action, resulting from the presence of the spiral oil-way, gives a constant, though small, supply of oil upon the gears. The gears do not dip in oil, though the case which encloses them receives drainage from all the bearings.

The governor is connected with the driving shaft, of which, at first sight, it appears to be but an extension. It is shown in detail in fig. 2. The weights, W, W, with their arms, C, C, are in the form of a split cylindrical cup. Upon the outside and at the base of each weight a knife edge E, E, is formed, which bears upon a suitable surface in the governor frame, A, A. A spiral spring is fitted at its inner end with two projecting pins, which bear upon the arms, C, C, of the governor weights. The outer end of the spring is connected with the frame by the threaded plug, D. When the governor is at rest the concave surfaces of the weights are in contact with the frame, and the tension of the spring keeps the knife edges upon their seat. When the governor is revolving at speed the weights are under centrifugal action and move outward, swinging upon their knife edges, against the resistance of the spring. The motion of the weights is taken up by the pin, F, by which it is communicated, through suitable mechanism (not shown), to the governor valve above the engine.

The nozzles which serve to deliver steam to the wheel are four in number, and are so fixed in the frame of the engine as to act upon the turbine wheel at points which are equally distant from each other. Two of the four are provided with stop-cocks, which, when closed, put out of action the nozzles with which they are connected.

* Presented at the New York meeting (December, 1895) of the American Society of Mechanical Engineers.

† "Tests of a 10-Horse-power de Laval Steam Turbine," a thesis by Charles E. Bruff, 1895.

By means of the stop-cocks, therefore, the engine may be run under the action of two, three, or four nozzles, at the will of the engineer.

The distinguishing feature of the engine, perhaps, is to be found in the form of the nozzles. All are diverging, the throat or smallest diameter being approximately 2 inches from the discharge end. Three have a diameter in the throat of 0·138 inch, and one a diameter of 0·157 inch.

It is assumed that the form of the nozzles is such that the pressure of the steam as it passes from the orifice will be that of the surrounding medium, and, since the flow is nearly adiabatic, it is clear that if this condition is realised all the energy of pressure is transformed into energy of motion before the steam is allowed to impinge upon the buckets of the turbine wheel. The medium surrounding the nozzles in the machine is practically that of the exhaust, so that the expansion from the pressure of the boiler to that of the exhaust is complete before the steam has contact with any moving part of the machine.

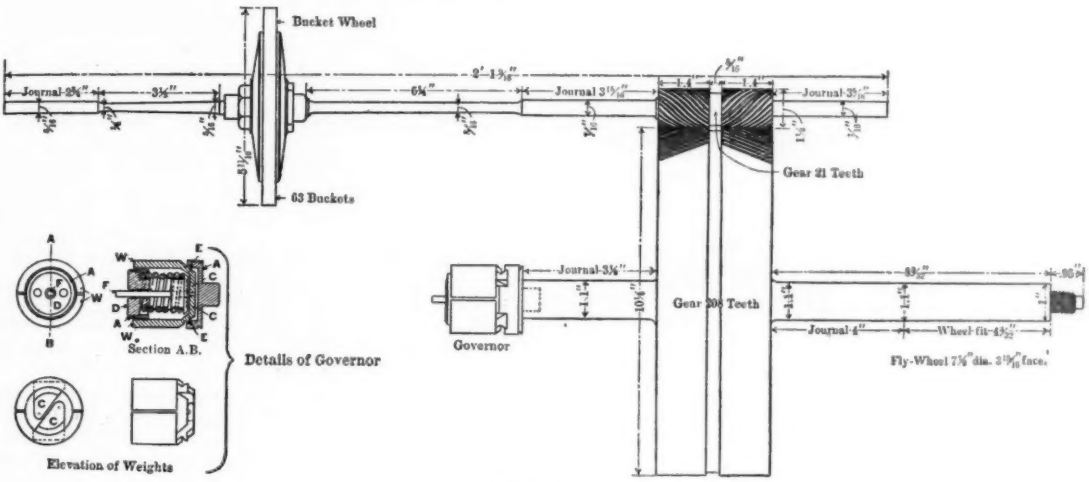


FIG. 2.

Lateral motion of the driving shaft is limited by contact between the large gear and the bearings on either side. With this shaft fixed, the double spiral of the gears makes lateral motion of the turbine shaft impossible. All forces, therefore, tending to displace the turbine wheel laterally are transferred to the slow-moving shaft, where ample rubbing surfaces can be provided without seriously impairing the efficiency of the machine through frictional losses—a happy solution of an otherwise difficult problem. When it is remembered that the parts shown (fig. 2) are those of a machine capable of developing 10 horse-power, that the driving shaft under normal conditions makes 2,500 revolutions a minute and the turbine shaft practically 10 times as many, the opportunity for the display of good design and workmanship may be better appreciated. Viewed as a piece of mechanism, the engine tested appears to merit high commendation, both as to design and workmanship, but the service which has thus far been obtained from it is not sufficient to show the effect of long-continued use.

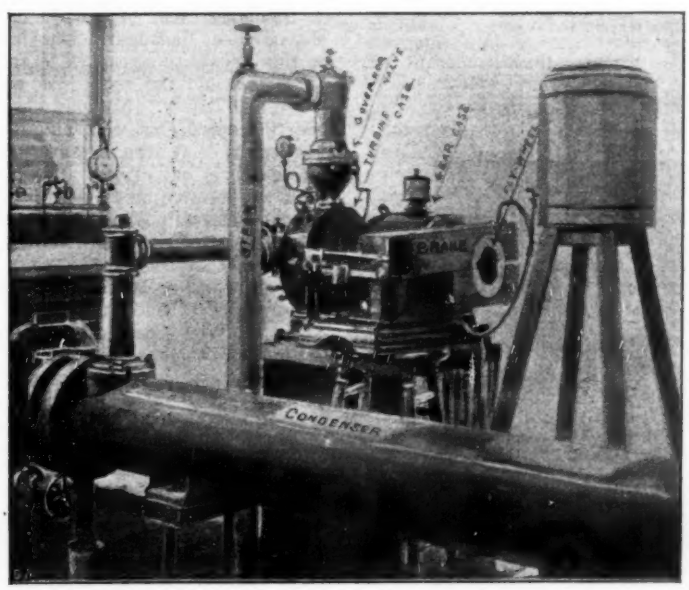


FIG. 3.

## II.—THE TESTS.

*Arrangements for Testing.*—Fig. 3, from a photograph, shows the engine with its auxiliary apparatus. The power of the engine was absorbed by a Pony brake, cooled by constant streams of water. The exhaust steam was piped to a Wheeler condenser, open to the atmosphere. The water resulting from condensation was drained into tin buckets, which were changed and weighed at regular intervals.

Gauges were used to show the steam pressure both above and below the governor throttle, the former giving the pressure available at the engine, and the latter the pressure under which, in consequence of the action of the governor, the steam was admitted to the nozzles. A manometer was also attached to the exhaust pipe, but as this pipe is large (3 inches diameter) and the connection with the condenser close, the observed pressure was never appreciably different from that of the atmosphere.

*Conditions and Results.*—The boiler pressure for all efficiency tests was 130 lbs. by gauge, for which pressure the particular nozzles used were designed. The rated speed of the fly-wheel is 2,400 revolutions per minute (23,771 for turbine wheel), but this standard was not maintained for all the tests. The governor was adjusted several times as the work progressed, and it was not until several tests had been run that the proper speed was secured. It is believed, however, that the differences of speed recorded do not materially affect the value of results for purposes of comparison.

The tests are grouped into three series, the first including those for which all four nozzles were in action, the second those with three, and the third with two. The several tests in each series were intended to vary from each other only in amount of power delivered from the wheel. All tests were of 30 minutes' duration, and all observations were taken at five-minute intervals. The conditions of each test were maintained with such uniformity that the observations of any five-minute interval were very nearly identical with the average of all observations taken for the test.

The observed and calculated results appear in tabulated form (Table I.).

It will be seen that, with all four nozzles in action, and with the engine developing a little more than its rated power, the steam consumption per horse-power per hour is as low as 47·8 lbs. In comparing this result with results obtained from other engines, the small size of the engine tested (10 horse-power) should be kept in mind, and also the fact that the rate of consumption stated is based upon brake power. The efficiency of the engine falls off rapidly as the load is decreased, and, as would be expected, the effect is most marked when all the nozzles are in action. This may best be seen by means of the three heavy-lined curves given in fig. 4. Assuming the nozzles to be cut out of action at one time, as soon as the reduction of load becomes sufficient to permit the work to be done without them, the minimum steam consumption at different loads, for the boiler pressure and speed employed, is represented by the broken line, *f*, *g*, *d*, *e*, *b*, *c*, fig. 4. Again, if, instead of four nozzles, an infinite number could be employed, and if the governor could be arranged so as to regulate the number in action, rather than the pres-

sure admitted to them, the steam consumption of the engine in question might be made to follow a line somewhat similar to the light broken line, *g*, *e*, *c*. But the heavy lines indicate the results which were actually obtained.

Table I.—A Summary of Results of Tests.

| Nozzles. | No. of test. | Revolutions per minute of belt wheel. | Brake horse-power. | Steam pressures by gauge. In boiler. | Steam pressures by gauge. In engine below governor valve. | Total lbs. of steam per hour. | Lbs. of steam per brake horse-power per hour. |
|---|---|---|---|---|---|---|---|
| All four nozzles in action, three having a diameter in throat of 0·138 inch and one a diameter in throat of 0·157 inch. | 1 | 2,138 | 0·00 | 130 | 17·1 | 120·8 | ... |
| | 2 | 2,545 | 1·63 | 130 | 42·2 | 210·3 | 128·6 |
| | 3 | 2,038 | 2·36 | 130 | 48·5 | 230·8 | 99·8 |
| | 4 | 2,118 | 2·97 | 130 | 55·6 | 254 6 | 85·7 |
| | 5 | 1,917 | 3·46 | 130 | 61·9 | 275 5 | 79 6 |
| | 6 | 2,072 | 4·38 | 130 | 70·8 | 313·0 | 71·5 |
| | 7 | 2,128 | 5·10 | 130 | 76·9 | 328·5 | 64·4 |
| | 8 | 2,576 | 7·52 | 130 | 99·6 | 403 0 | 53·6 |
| | 9 | 2,453 | 8·24 | 130 | 104·4 | 422 8 | 51·3 |
| | 10 | 2,411 | 1 ·33 | 130 | 126·3 | 491·8 | 47·8 |
| Three nozzles in action, two having a diameter in throat of 0·138 inch and one a diameter in throat of 0·157 inch. | 11 | 2,584 | 0·00 | 130 | 3 ·3 | 121·4 | ... |
| | 12 | 2,112 | 3 95 | 130 | ›3 6 | 267 8 | 67·8 |
| | 13 | 2,125 | 4·77 | 130 | 93·4 | 286 0 | 60 0 |
| | 14 | 2,490 | 6·50 | 130 | 111 7 | 346 3 | 53·3 |
| Two nozzles in action, each having a diameter in throat of 0·138 inch. | 15 | 2,546 | 0 00 | 130 | 42·2 | 99 3 | ... |
| | 16 | 2,049 | 1 95 | 130 | 83·5 | 162 6 | 83·4 |
| | 17 | 1,909 | 3·43 | 130 | 121·1 | 222 9 | 65 0 |
| | 18 | 2,412 | 3 87 | 130 | 127 0 | 2·9 6 | 59·3 |

The engine requires very little attention and is almost noiseless in action. The governor is quick to act, and its speed regulation appears to be fair, except when changes of load are large and suddenly made. After such a change, the engine requires a little time before settling down to steady running under the new conditions.

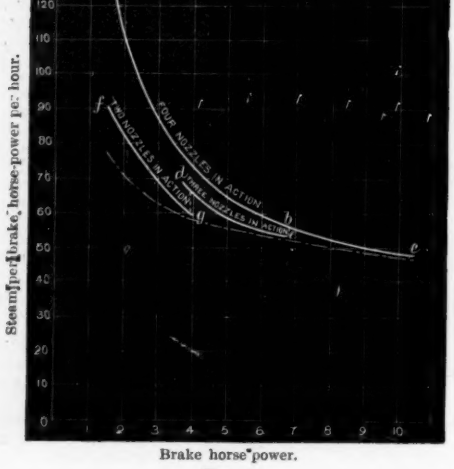
Steam per brake horse-power per hour.
Brake horse-power.
FOUR NOZZLES IN ACTION.
THREE NOZZLES IN ACTION.
TWO NOZZLES IN ACTION.

Fig. 4.

*Starting Power.*—As the speed of the De Laval engine is high, it is evident that the force in action must be comparatively low. To determine the maximum resistance under which the engine might be expected to start, the brake was clamped upon the fly-wheel so that the latter could not turn within it. Steam was then admitted to the engine, and readings were taken from the scale under the brake arm. The result of this process, of course, depends upon the steam pressure and the number of nozzles in action. With all nozzles, and with a steam pressure of about 125 lbs. by gauge, the maximum starting power is equal to a force of 30 lbs. acting at a radius of 1 foot. The following tabulated data (Table II.) gives the starting power for different pressures, and when two, three, or four nozzles are in action.

Table II.—Starting Power of Engine.

| | Four nozzles in action. | | Three nozzles in action. | | Two nozzles in action. | |
|---|---|---|---|---|---|---|
| Steam pressure by gauge ... | 125·2 | 71·1 | 125 2 | 71·1 | 125·2 | 71·1 |
| Effective radius of brake arm, feet ... ... ... ... | 1·5 | 1·5 | 1·5 | 1·5 | 1 5 | 1 5 |
| Reading of scale under brake arm, pounds ... ... ... | 20·0 | 12·1 | 14·1 | 9·0 | 9·5 | 6 0 |
| Equivalent force in pounds, acting at a radius of 1 foot | 30 0 | 18·2 | 21 2 | 13 5 | 14·3 | 9·0 |

## THE TELEGRAPH AND THE CAPE.

A valued contributor writes:—There is an incidental lesson to be learned from the present crisis in the Transvaal, which should be taken note of. The *Standard* of the 4th inst., in a leader, says: "It is surprising, if not disquieting, that at so anxious a time as the present we seem to be almost entirely cut off from telegraphic communication with South Africa." One might go further, and say that although there was no absolute failure of communication electrically, there was such delay as, in the case of commercial messages, amounted to failure. The last independent telegram which the *Standard* had received at the time of going to press on the 4th inst. was dated the Cape, December 30th; the *Times* of the 6th inst. publishes a telegram dated Johannesburg, December 30th, and, moreover, Mr. Chamberlain, on Saturday afternoon, stated that owing to a block in the cable, said to have been on the West Coast, and possibly due to messages sent in connection with the Ashanti expedition, the Government itself had received no message of any importance on Transvaal affairs from 5 p.m. on the 2nd inst. until 4 a.m. on the 4th inst. The primary cause of this so-called block was the interruption of the Aden-Zanzibar section, which occurred on December 24th. The whole of the traffic from Zanzibar, Mozambique, Madagascar, and South Africa generally, had on this account to be carried by the cables on the West Coast of Africa, and the result was what can only be called a lamentable failure. Not only was all commercial work completely stopped, but, according to Mr. Chamberlain, there was serious delay even on Government messages, which take precedence of all others. Fortunately, the Aden-Zanzibar cable was repaired on the 4th inst., so that the block is by this time cleared off. It is believed that it is the intention of the Eastern Telegraph Company to duplicate this section* as well as that between Mozambique and Zanzibar. This done, there will be triple communication with the Cape, and a recurrence of such a state of affairs will be unlikely. That the West Coast cables should have been capable of dealing with the rush a good deal better than it did is a matter on which there can be no doubt, and considering that interruptions on the East Coast have taken place pretty frequently of late, it is not very creditable that the companies concerned should have been caught napping. Want of competition is at the bottom of the whole business. If the West Coast cables were free from the Eastern Company's influence, they would be always in competition for the Cape traffic, their staff and apparatus would be up to the mark, and on an emergency there would be no more delay from an interruption on the East Coast than there would be from one on the West Coast. Whatever may have been the cause, the companies concerned should see that it does not happen again. It is perfectly fair that on cables subsidised by Government, the messages of that Government should take precedence of all others; but that a line should be absolutely blocked by them is a thing which should not occur, and which will not be tolerated. When the war cloud, which is continually hovering over Europe, bursts, and Lord Salisbury, as Foreign Secretary, displays the same energy as Mr. Chamberlain as Colonial Secretary, are commercial men to calmly wait for the termination of hostilities before again resuming business negotiations by telegraph?

* The original cable between Mozambique and Zanzibar was laid in 1879. This cable, owing to frequent interruptions, was duplicated in 1885, it being the only section of this company's cables which has been duplicated.—Eds. Elec. Rev.

It is commerce, and commerce alone, which supports 90 per cent. of the submarine cables of the world, and although it is undoubtedly to the advantage of commerce that every facility should be given to a Government, commercial men will scarcely be likely to abandon their usual mode of communication for long, without taking serious steps to render a recurrence of such a thing impossible.

## CORRESPONDENCE.

### The Preliminary Examination in Electric Lighting.

Before the Preliminary Examination was instituted, I, on more than one occasion, urged the necessity for such a test. Since then, I have frequently suggested (*e.g.*, "Elementary Class Teaching," in last week's issue), that the non-granting of certificates to a great extent defeated the object of the examination, assuming that object to be the encouragement of electrical education among workmen, and I feel sure that the majority of teachers and students will agree with me.

My reasons for thinking that the issue of certificates is highly, not to say imperatively, desirable, are briefly as follows:—

(1) Greater attention would be given by committees and teachers to the requirements of the Preliminary Grade; in the way of separate classes, outfit, and time devoted to instruction.

(2) There would be less tendency to rush students through to Ordinary Grade work.

(3) As a consequence of (1) and (2), and for the sake of the certificates, numerous students (workmen and others) who are incapable of attacking any higher examination, would join such classes.

Of the great value of this examination, and of certain practical additions which might advantageously be made to its syllabus, I do not propose to treat, as I think they are self-evident.

Bearing in mind the insignificant additional cost of issuing these certificates, the City and Guilds of London Institute would be almost sure to agree thereto, if it were proved that there was a general concensus of opinion in favour thereof.

To this end, I would ask both teachers and students to put forward their own ideas on the subject.

**W. Perren Maycock.**

*January 4th*, 1896.

### Fires at Electric Lighting Stations.

The remarks of Mr. Geo. N. call to mind an incident which occurred in a large accumulator room. A friend, who was of a scientific turn of mind, was asking questions, and, upon being told that the gases which were being given off were oxygen and hydrogen, looked at a regulating cell of 66 plates which was bubbling freely, remarking that those gases ought to unite and form water upon a light being applied.

The experiment was tried, with the result that the glass cover of that section was blown to atoms—to be correct, pieces not larger than 3 inches square, and a great number of very small pieces scattered to 20 feet distance. This was accompanied by a report as loud as that of a fowling piece. The acid was also spattered about. The experiment was not repeated, owing to unpleasant effects upon hands and face. The incident, though not to the point, suggests that street box explosions are probably due to similar causes, *i.e.*, electrolysis in confined places.

**Arthur H. Gibson.**

*January 4th*, 1896.

### The Geometrical Form of Transformer Plates.

*Re* figs. 1 and 2 in your issue of December 27th, Mr. Geo. Adams states that the form of plate shown in fig. 2 is better than the form shown in fig. 1. I should like to point out that the form, fig. 1, has an advantage over the other form, as it presents much less air gap resistance, and consequently requires less magetising current.

**G. Kemp.**

### Earthed Centre Main.

In connection with possible dangers from the use of pressures of from 400 to 500 volts on the mains of electrical supply companies, I beg to hand you the following opinion from Mr. Musgrave Heaphy, who has recently discussed this matter with me. I need scarcely state that an opinion from this gentleman, who has such unrivalled advantages for estimating the dangers of electric power distribution is worth serious attention.

It is commonly assumed in a three-wire system of supply, with centre wire earthed, that it is impossible for there to be a difference of pressure on any premises wired on one side of the system greater than that between one of the outers and the middle wire. Mr. Heaphy points out that the full pressure may be brought into one house under certain conditions.

Assume two adjacent houses, the one connected to the positive and middle wire and the other to the middle wire and the negative; and let there be in the party wall: (*a*) an iron door frame, wall box or piece of shafting, &c., communicating between the two houses, insulated by dryness of the wall, by dry woodwork, or other means securing practical insulation. Or (*b*), leakage of water on to a portion of the party wall thus insulated.

Assume accidental connection between one of the outer mains, say through a defective flexible wire to one of the insulated pieces of metal, or to the damp portion of the wall. The leakage to earth will be probably too small to blow the fuses and so to disconnect the house.

Next assume an accidental leak on the other pole of the system in the adjacent house, say through the metal case of a switch or lampholder.

It is clear that if the piece of insulated iron or damp wall be touched at the same time as the defective fitting that a shock due to the full pressure will be felt.

These conditions are not likely to occur often, for two earths on opposite poles have to be made concurrently and in adjacent houses, yet the risk is increased by the consumer's difficulty of detecting either leak except by a shock.

An obvious safeguard is to earth all isolated pieces of metal, but this does not get over the risk from walls which are damp locally. Iron barrel or concentric wiring, with the outer earthed, appear to be the safest methods of wiring under the conditions assumed. For, with either it is probable that a single leak would blow one of the fuses and thus call attention to the defect.

In fact, if the middle wire be earthed, all iron work in buildings should be effectively earthed also.

**Albion T. Snell.**

### The Audit of Electric Light Company Accounts.

The correspondence between the Institute of Chartered Accountants and the Board of Trade, with reference to the audit of electric light companies' accounts, opens up several very interesting questions.

It is not perhaps generally known that there is no enactment in the Companies' Acts requiring an audit of a limited company's accounts, except in the case of a banking company registered after August 15th, 1879, as a limited company.

It is true that the specimen form of articles given in Table A of the Companies' Act of 1862, provides for an audit, and that it is most unusual for any company to dispense with provisions in its articles requiring an audit, but an audit is not made obligatory by Act of Parliament.

By Section 9 of the Electric Lighting Act of 1882, it is provided as follows:—

> 9. The undertakers shall, on or before the 25th day of March in every year, fill up an annual statement of accounts of the undertaking, made up to the 31st day of December then next preceding, and such statement shall be in such form and shall contain such particulars and shall be published in such manner as may from time to time be subscribed in that behalf by the Board of Trade.

And the model form of provisional order provides as follows:—

> 8. The annual statement of accounts of the undertaking, before being published, as provided by Section 9 of the Electric Lighting Act, 1882, shall, so long as the local authority are not the undertakers, be examined and audited by such competent and impartial person as the Board of Trade shall appoint, and the remuneration of the auditor shall be such as the Board of Trade shall direct, and the

same and all expenses incurred by him in or about the execution of his duties, to such an amount as the Board of Trade shall approve, shall be paid by the undertakers on demand, and shall be recoverable summarily as a civil debt.

The undertakers shall give to the auditor, his clerks and assistants access to such of the books and documents relating to the undertaking as shall be necessary for the purposes of the audit, and shall when required furnish to him and them all vouchers and information requisite for such purpose, and shall afford to him and them all facilities for the proper execution of his and their duty.

The Board of Trade may make and vary regulations prescribing the times at and the mode in which such audit shall be made and conducted or otherwise for the purpose of giving effect to the provisions of this section.

Any report made by the auditor, or such portion thereof as the Board of Trade shall direct, shall be appended to the annual statement of accounts and shall form part thereof for the purposes of the said Section 9.

There is no clause similar to Section 9 of the Act of 1882 in the Gas Works Clauses Act or in the Railway Clauses Act, and the Companies' Clauses Act of 1845 merely provides for the election of auditors *by the company*, except where by the special Act auditors shall be directed to be appointed otherwise, and these auditors are directed to examine the accounts and either to make a special report on the accounts or simply to confirm the same: such report or confirmation to be read with the report of the directors at the ordinary meeting.

On the other hand, the Metropolis Water Act of 1871 provides that every company, for the time being, supplying water for domestic use within the limits of the Act, is to forward to the Board of Trade and certain other authorities a statement of account in such form, and giving such particulars as may from time to time be prescribed by the Board of Trade, and there is to be an auditor from time to time appointed by the Board of Trade.

Section 40 of this Act provides as follows:—

40. The auditor shall, once in every half-year, audit the accounts of the companies.

If he finds the accounts correct he shall certify the same, but if in any instance he finds the accounts of any company incorrect in principle or in detail, he shall require such company to correct such accounts in such manner as he thinks right, and no future dividend shall, in any case, be declared by any company until their accounts are certified by the auditor, provided that the suspension of a dividend under this section shall not operate until after the expiration of nine months from the date of the audit.

But any company thinking themselves aggrieved by any Act, or determination of the auditor, can, under Section 42, bring the matter to arbitration.

Now it will be noticed that there is a great deal of difference between the provision for the annual statement of accounts to be made to the Board of Trade under the Electric Lighting Act, even when coupled with the audit clauses of the Provisional Order, and the provisions of the Metropolis Water Act of 1871, under which power is given to the auditor to require a company to *correct* any accounts which he finds incorrect in principle or in detail. And I submit that the audit of an electric lighting company's accounts by the Board of Trade is merely made for the purpose of obtaining independently statements as to the expenditure, and as to the application of revenue with a view to the special provisions of the Act and provisional order, and particularly with a view to the anticipated purchase by the local authority at the expiration of the statutory period, and that the Board of Trade Auditor has no power to direct such a company to alter its accounts in principle or in detail unless he can show that the company has committed a breach of the terms of the Electric Lighting Acts or provisional order.

The letter from the Board of Trade recently published states, as I claim in support of this suggestion: "that the Board of Trade audit is of a different character to that of a shareholder's audit, and has in view different objects." Moreover, *there is no audit clause in the model provisional order the "undertakers being a local authority."*

Now the object for which the shareholders audit is made is that as between the directors and the shareholders it shall be shown that capital is not paid away in dividends—that all payments are duly vouched and all receipts duly entered, and proper provision made for bad debts or contingent liabilities, and, in fact, that the accounts are properly kept, having regard to the constitution of the company.

If the above suggestions are correct the importance will at once be seen of drawing the line between the two audits, and limiting the rights of each auditor to interfere in the management of the accounts to the special provisions under which his appointment is made.

If this is not done, each auditor may, by degrees, get into the way of directing, not only how the accounts shall be kept, but also what amounts are properly chargeable to capital and revenue respectively, and if they do not take the same view, very serious difficulties may arise, whereas if, as I submit, the duties of the Board of Trade auditor are limited to ascertaining and seeing that the provisions of the Acts and Order are duly carried out, while the shareholders' audit deals with matters arising out of the special constitution of each company, and the proper keeping of the accounts, there need be no difficulty.

But I do submit that there is this distinction, and that it should be carefully observed.

**Sydney Morse.**

## BUSINESS NOTICES, &c.

**An Electric Light Standard for Workshop Benches, &c.**—Mr. George Stegmann, of 69, St. John's Hill, Clapham Junction, S.W., has brought out a very useful light standard admirably adapted for the workshop. It is a telescopic standard having at its

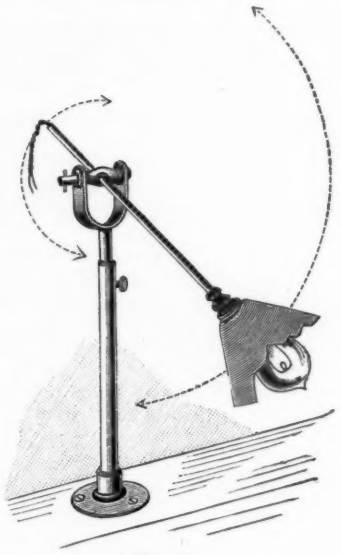

Fig. 1.

upper end an adjustable socket for the reception of a tube carrying the wires, and an incandescent lamp. This socket is so arranged that the light may be brought down close to the work as shown in fig. 1,

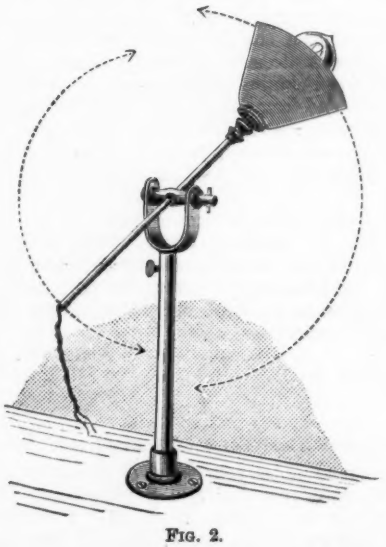

Fig. 2.

or it can be turned round in any direction, as shown in fig. 2. If desired, the tube carrying the wires and lamp may be withdrawn from the socket, and the light used under the bench, which

obviates the use of naked lights, thus materially lessening the great number of fires in workshops so general at the present time. The standard is claimed to be strong and well made, and is placed on the market at a moderate price. The standard should certainly prove useful to anyone requiring an adjustable light.

**Bankruptcy Proceedings.**—The *London Gazette* contains notification of release of trustees as follows:—W. H. Akester, electrician, of Fulham Road, release of senior Official Receiver, Mr. George Wreford; dated November 30th, 1895. E. P. Oliver, electrical engineer, 50, Great Sutton Street, E.C., release of Official Receiver, Mr. E. Leadam Hough; dated December 3rd, 1895. Release, dated December 28th, 1895, of official receiver Mr. E. G. Clarke, in the case of J. H. Hale, India-rubber merchant and electrician, of Stanton Drew and Bristol.

**Book Received.**—"Electricity and Magnetism," Elementary treatise founded on Joubert's "Traité Elémentaire d'Electricité," by G. C. Foster, F.R.S., and E. Atkinson, Ph.D. Published by Longmans, Green & Co. Price 7s. 6d.

**Calendars, Price Lists, &c.**—A very elaborate production is the new catalogue of the General Electric Company, Limited, of Queen Victoria Street. It contains 700 or 800 pages of illustrated and priced descriptive matter of the firm's manufactures and wares in the electrical line. The book, however, goes beyond the purposes of an ordinary catalogue, inasmuch as it contains certain information which tends to increase its value. It abounds in interesting illustrations. Some hardly excusable misprints of authors' names occur, and there is a system of paging which will bear improvement, but the work of preparation was, no doubt, very considerable. Among the usual descriptive matter we observe diagrams with full instructions for estimating, wiring, erecting, working, and thoroughly carrying out an installation of from 1 H.P. to 1,000 H.P. continuous, alternating, or polyphase currents with steam, gas, oil, or water motors; tables of fuses and estimates for lamps, wire gauges, and instructions for jointing according to all the known systems of wiring; diagrams for wiring and installing telephone systems; useful notes upon the application of electricity written in a popular style; instructions and diagrams for fitting electric bells. A special section is devoted to direct and alternating current motors and their application. The principle, construction, action and efficiency of the electric motor are explained by the aid of diagrams and tables. The constructive portion also includes graphic directions for installing electromotor plant, and estimating for it. A section is also devoted to electro-therapeutics. Specimen estimates for installations of arc and incandescent electric lighting with house, plan, and switch wiring are given. There is also a glossary of electrical terms. Many of our readers will find the catalogue of great service.

Messrs. Nalder & Harrison, Limited, have sent us a circular giving four photographic views of their workshops. There are two views of the large machine shop, one of the planing and slotting machine shop, and one of the brass finisher's shop. One of the views is shown in the firm's advertisement this week.

Messrs. King & Co., of Leith Electric Works, Leith, have sent us a nicely prepared calendar for 1896. A centrepiece contains several small photographs of work done by the firm.

Messrs. Cox-Walkers are sending out the season's compliments with a tablet calendar for 1896, which is very handy for memorandum purposes.

A calendar for 1896 has also come to hand from Messrs. J. H. Sankey & Son, of Canning Town.

From the Chloride Electrical Storage Syndicate we have received a copy of their neat pocket catalogue (4th edition). The book, which is very nicely got up, contains a great deal of useful information regarding the company's accumulators. There is a calendar included for 1896, also blank pages for notes.

Messrs. Englebert & Co., of Bishopsgate Street, have issued an 1896 calendar, with a separate sheet for each month, and have also arranged an 1897 calendar at the back thereof, which is a very handy arrangement.

A capital calendar for cyclists has been issued by the Pope Manufacturing Company of the U.S.A. A slip for each day allows space for memoranda, and at the top is a selection of literary gleanings.

**Casings.**—We have received from Messrs. Beecroft and Wightman, of Garnett Street Mills, Bradford, a specimen of electric light casing, which is well made and of good material.

**Change of Address.**—Messrs. W. F. Dennis & Co. have removed from 11, Billiter Street, E.C., to more convenient offices, at 23, Billiter Street, E.C.

Mr. C. A. Hemingway, of Richmond, in order to fully cope with increased business, has opened offices at 39, Victoria Street, S.W. Both branches will be under his personal supervision.

**Commercial Cable Company.**—Mr. G. H. Bambridge has resigned his position with the Commercial Cable Company, and Mr. Frederick Ward has been appointed manager in England in his stead.

**Lundberg Switches.**—Mr. A. P. Lundberg, learning that someone is spreading a report that he has relinquished the manufacture of the "Unique" pattern switch, asks us to contradict the rumour.

**Partnership.**—Mr. J. H. Sankey, cement merchant, &c., of Canning Town, E., announces that he has taken into partnership his son, Charles Herbert Sankey, who has taken an active part in the business during the last 15 years. The name of the firm will be J. H. Sankey & Son.

**Personal.**—Mr. B. H. Thwaite, civil engineer and metallurgist, has opened a Westminster office at 29, Great George Street, S.W.

**The Year's Work:—**

**Messrs. Browett, Lindley & Co., Limited,** of Patricroft, report that they have very much increased their output of engines for electric lighting and other purposes during the past year, in fact, it has been the largest since they commenced business. To meet the increased demands, a good many new machine tools have been installed, and others are now in progress. Their standard vertical electric lighting engines, chiefly for direct driving and use on shipboard, have furnished the firm with the bulk of their orders, something over 100 engines having been supplied. They have also had during the year a fair share of heavier and central station work, amongst which may be mentioned the completion of the Salford Electric Lighting Station contract, a 250-H.P. engine for Derby extension, and two 220-H.P. engines for Ealing extension, also three 350-H.P. and one 250-H.P. engines of the vertical compound type for the British Plate Glass Company, Limited, St. Helen's, two of which are now installed, and the other two nearing completion. Also several engines from 100 to 200-H.P. have been delivered during the year, including two for Spain, one for France, two for Russia, and one for the extension of the lighting of Messrs. R. Haworth & Co.'s mill. The firm have also supplied the whole of the pipe work, and the surface condensing plant for the electric generating station of the Dublin electric trams, and also a surface condensing plant to the Southport Corporation for their electric lighting station. During the year, also, two of their special horizontal high speed engines have been supplied to the General Traction Company, Limited, of London, for driving the generators at the Coventry Electric Tramway Station, also coupled electric light plants for the Waterloo and City Railway Company, London, and the Ravenhead Plate Glass Works, St. Helen's. The company also report very satisfactory prospects for the new year, they already have several good orders to commence work with.

**Messrs. Johnson & Phillips** report that during the year all their departments have been uniformly busy. The manufacture of alternators, dynamos, transformers, and central station accessories has surpassed that of previous years. The firm have been very busy on several large contracts, which include transmission of power plants for South Africa, alternators for the St. Helen's Corporation, and the station plant for the Cape Town Electric Lighting Company. Orders for transformers continue to pour in; several of 100 kilowatts are now being constructed, and the sizes on order vary from this to half a kilowatt. The cable-machinery department has been very busy on stranding, cable-making, and wire-covering machines, both for this country and abroad, and has also had in hand the picking-up and paying-out machinery, accessories, and stores forming the complete equipment for the Japanese Government's cable steamer. The arc lamp department has been kept exceptionally full of orders, especially during the latter part of the year, and contracts have been secured from Portsmouth, Brighton, Taunton, South Shields and Edinburgh, also for the lighting of Johannesburg. The total orders are much in excess of the previous year. The new type of Brockie-Pell lamp introduced at the beginning of last year is stated to be rapidly gaining favour. The firm are now putting down special tools for still quicker production. An exceedingly large business has also been done in carbons. The cable department has been chiefly occupied during the year with the manufacture of vulcanised rubber cables for wiring purposes and underground use. High tension concentric mains have been completed in connection with the lighting of London, Walsall, and Malta, as well as a large quantity of single mains for various towns at home and abroad. The Brooks oil-insulated cables have been supplied for the wiring of the Glasgow Harbour Tunnels, the wires being insulated with oil right up to the incandescent lamp holder. It is interesting to note that the use of this system for this class of work has been a great success, and the firm looks forward to see during the present year a number of mines, tunnels, and underground railway stations lighted on this principle. In the meter department every effort has been necessary to meet the steadily increasing demand, and standard designs for all sizes, from 5 to 1,000 amperes, have been prepared in addition to those in use at the beginning of the year. From these designs, instruments of all sizes have been stocked and sold. Very extensive additions to the instrument shops have been made for rapidly and accurately testing these instruments. The plant put down early in the year has been kept fully occupied, and should the sales continue to increase at the same rate, further additions will very shortly be needed. The outlook for 1896 is regarded as extremely hopeful.

**Messrs. Drake & Gorham.**—We are informed that during the past year this firm have made the usual progress, and it has been found necessary to enlarge the offices to accommodate the additional staff required, as well as to increase the showrooms of the firm's specialties and fittings. The branch at Manchester has been exceedingly busy; and arrangements are being made for opening another branch at Glasgow to facilitate the carrying out of the Scotch business. Among the more important of the country installations in hand during the year may be mentioned:—Crewe Hall, for the Rt. Hon. The Earl of Crewe, 550 lights (steam plant); Windlestone Hall, for Sir William Eden, 300 lights (steam); Sir William Farmer's, near Ascot (oil engine); Major Kearsley, Nantwich; W. H. Oakeley, Esq.; A. H. Brown, Esq., M.P., near Dorking (steam); J. Murray Johnson, Esq.; F. Power, Esq., Farningham (water turbine); Capt. Ormrod (steam); W. Drury Lowe; Herbert Strutt, Esq., Belper (water turbine); C. C. Wyllie, Esq., Esher (oil engine); J. Van Raalte, Esq.; J. Cannon, Esq.; E. H. Hills, Esq.; Capt. Boothby; W. Lancaster, Esq., &c., &c. The following are some of the town houses:—The Rt. Hon. Marquis of Lansdowne, Secretary of State for War; His Grace the Duke of Montrose, Pont Street; Devonshire

House extensions; The Rt. Hon. Lord Wynford; Forbes Leith, Esq.; Sir Richard Quain, F.R.S., &c.; Sir William Power; Prof. Kennedy, and many others. Among the important public buildings, &c., the firm have in hand the whole of the generating plant for the Prudential Assurance Company, comprising two sets of 250 H.P. each, one set of 75 H.P., one set of 50 H.P. Also, the Stafford Technical Schools, 1,100 lights; Balliol College, 370 lights; Convalescent Home, Littlehampton, 230 lights; Stafford County Infirmary, 230 lights; Cancer Hospital, 320 lights; Lancaster Infirmary, 240 lights; St. Paul's, Deptford, 110 lights; St. Michael's Church, Chester Square, 200 lights; Manchester Corporation Gas Stove Showrooms; University Galleries, additional arcs and incandescents; Council of Foreign Bondholders; South Eastern Railway Company's offices, Tunbridge Wells; North Eastern Railway Company's offices; Messrs. S. Allsopp and Son's offices, &c., &c. The factory of the "Jandus Arc Lamp and Electric Company" has been organised, and special machinery made for turning out every separate part, so that the Jandus arc lamp is now being put on the market upon a thoroughly commercial basis. These lamps are stated to burn from 120 to 200 hours, according to the current for which they are constructed. The "D P." battery business during the year has been turned into a private company, the directors being Mr. Claude Johnson (of Messrs. Johnson & Phillips), Mr. Bernard M. Drake, and Mr. Gorham. The sale of the earthing device has considerably increased, and 3,500 of these are now in daily use. It is held that no single case is known to have occurred of the apparatus having failed to effect its purpose.

**Mr. A. P. Lundberg** reports that business done in 1895 shows a great improvement on that done during 1894. The "Unique" switch has nearly reached a sale of 90,000 from his works alone, and is being made and sold by licensees on the continent. He expects to place several novelties on the market shortly. Continental competition has been successfully met, and some satisfaction is obtained by sending fair quantities of goods to Germany and other important continental countries. Business with the colonies and other countries abroad has considerably increased, particularly Australasia, South Africa, India and South America. The year 1896 promises well.

## ELECTRIC LIGHTING NOTES.

**Alsager (Stoke-on-Trent).**—At the meeting of the Urban District Council, on 1st inst., the question of lighting the village came up for further discussion, and it was resolved: "That it is desirable to light the village by electricity, and that steps be taken for that end during the present year." No further steps are to be taken in the matter until the ratepayers have been consulted. The Council has been aided to come to this decision by the report of Mr. G. R. Peers, A.I.E.E., consulting engineer, of Manchester, who, after visiting the district, submitted a scheme for the proposed installation, and also addressed a ratepayers' meeting.

**Blackburn.**—A private installation has just been put down at the works of Messrs. Grice & Co., Walpole Street, Blackburn, by the Blackburn Electrical Engineering Company.

**Blackpool.**—The Council on 7th inst. remodelled the discounts on the 6d. per unit charge. It was stated that if some change had not been made in order to cover cost of production they would have had to stop the works. The altered discounts would make it so that large consumers will not be supplied at the expense of the rates.

**Bristol.**—The question of electrically lighting the Mansion House is under consideration.

**Bristol (St. George).**—The Town Clerk of Bristol has written to the St. George District Council, asking whether they intend opposing the application of the Great Western Electric Lighting Company for powers to light St. George. The Council had already decided to oppose, and informed Bristol to that effect.

**Belfast.**—It is stated that up to the end of the year, the electric light undertaking has shown an actual working profit of £350 or £400.

**Colchester.**—There was a discussion, the other day, as to whether the Council should put their electric lighting powers into force, and engage an expert to advise. Ultimately it was resolved to adjourn further consideration until January 16th.

**Chelsea.**—Twelve tenders were sent in for fitting up the infirmary extension. They have been referred to the General Committee for report.

**Cheltenham.**—In connection with the recent fatal accident here, the electrical engineer reported to the Council the other day that he had protected the high pressure switchboard in the High Street sub-station with an ebonite lined box; that he had ordered an additional rubber mat for each of the sub-stations, and that, failing other means of ensuring personal safety, he proposed to fix the high pressure boards to the sub-station roofs. Satisfactory progress continues to be made in connecting new customers; the equivalent of 5,050 8-C.P. lamps have already been connected, assuming that Mr. Bingham's installation, when completed, will be equivalent to 600 8-candle-power lamps; and there are, besides, customers who will have the equivalent of some 500 C.P. lamps, who will be ready for supply within the next few weeks. Last month the number connected was reported as 4,300.

**Clacton.**—The Council is to shortly consider whether to invite tenders for the electric lighting of the town.

**Clapham.**—The Surveyor reports that an electric cable had been laid from Manor Street to the business premises occupied by Messrs. Richard Grice & Son, 108, High Street, formal notice of same not having been given to the authorities. The matter is to be considered.

**Derby.**—The new offices of the County Council are lighted throughout electrically, the supply being taken from the Corporation mains.

**Eccles.**—The ratepayers are to be informed by circulars of the details of the electric lighting scheme considered by the Lighting Committee.

**Exeter.**—On Thursday, January 16th, a Local Government Board inquiry will be held into the application of the Council for power to borrow £11,000 for electric lighting purposes.

**Edinburgh.**—Palmerston Place United Presbyterian Church is to be lighted electrically, the contractors for the installation being Messrs. Lowdon Brothers, Dundee. In all there are 170 incandescent lamps in the building, varying from 16 to 32 candle-power. Mr. Geo. Balfour prepared the plans.

**Fareham.**—The District Council last Friday resolved that in view of the result of the recent poll, the Council's solicitors be instructed to accept the offer of the Electric Light Company, made in Court November 28th, to carry out the contract dated August 16th, 1894, in lieu of paying the damages awarded, and to apply for a further stay of execution to enable the Council to complete the purchase.

**Hastings.**—The electric light is to be supplied throughout the whole of Highbury House School. Every room in the house is to be fitted. The gymnasium, which is in a separate building, is to be fitted with several hundred candle-power lamps, and the adjoining laboratory and carpenter's shop is to be installed likewise. Mr. F. Bruce has the contract.

**Huddersfield.**—According to the *Bradford Observer*, horses passing over a certain crossing on 4th inst. were visibly affected by electric shocks, owing to an alleged escape of electricity from the Corporation mains. Nobody was hurt.

**Islington.**—The date fixed for the visit of the Lord Mayor and Sheriffs to Islington, to publicly open the electric lighting works, is Wednesday, March 4th.

**Lincoln.**—The Council will oppose the application of the County of London and Brush Company for a provisional order, and is considering, through a Committee, whether to undertake the supply itself.

**Lynton.**—A provincial paper says that the electric light company, to meet the increasing demand, are constructing a reservoir on the top of Summerhouse, to supply additional motive power for their machinery.

**London.**—The National Skating Palace, in Argyll Street, Regent Street, opened on 6th inst., is lighted electrically.

**Mar Lodge.**—We learn that Messrs. P. C. Middleton and Co., electrical engineers, Aberdeen, have received the contract for the lighting and heating of Mar Lodge by electricity. The electricity will be generated by water-power on the estate, and the cost of the work is estimated at between £2,000 and £3,000.

**Macroom (Ireland).**—Arrangements are in progress for introducing the electric light into the district.

**Newport (Salop).**—A committee has been appointed by the District Council to consider the electric lighting question.

**Portsmouth Dockyard.**—All the workshops in the Dockyard are to be lighted by electricity, and the plant is now being laid down.

**Ripon.**—Consideration of the electric light question has been deferred for another month.

**Rochdale.**—Application is being made to the Local Government Board by the Council for power to borrow £500 for electrically lighting the Free Public Library. The annual cost of gas lighting amounted to £75, against £100 estimated for electric. It is, however, estimated that £10 per annum will be saved in book binding and £5 per annum in painting and cleaning.

**Russia.**—Messrs. Siemens & Halske are reported to have secured a contract from the municipal authorities of St. Petersburg for the electric lighting of the Ismailon and Wosressenski Prospekts in that city.

**Spain.**—Tenders have just been invited for the electric lighting of Orduna, a small town near Bilbao. Work is rapidly approaching completion on the establishment of a central station at Alcala de Henares. One is also about to be put in operation at Villanueva y Geltru.

**Tunbridge Wells.**—The neglect of lighting the side streets is complained about, and the Lighting Committee is seeing what can be done. The electrical engineer stated at the last Council meeting that the new plant will soon be ready at the central station to meet extensions.

**Wallasey.**—The engineer has proposed to establish a system of electric lighting for the district. The scheme provided for nearly the whole of the district, and estimates the cost at £12,500. For this they would have plant on the high tension alternating current system, working at 2,000 volts, reduced by transformers. Transformers would be fixed at New Brighton, Egremont, Seacombe, Liscard, and Wallasey. The generating station would be on the site of the Liscard pumping station, with mains through Liscard, down Manor Road, Seabank Road, Rowson Street, and Victoria Road; also along Warren Drive and Grove Road to Wallasey Station; Manor Road, King Street, Trafalgar Road, Brighton Street, and Church Road to Seacombe Ferry. Several councillors think the work will cost a good deal more than £12,500. An amendment, referring the matter for expert opinion, was lost by five votes to 14, and the minutes were then passed.

**Weybridge.**—The Committee has reported to the Council against continuing negotiations for the purchase of the Weybridge Electric Supply Company's provisional order.

**Wimbledon.**—At a meeting of the District Council on the 1st inst., a letter was read from the Local Government Board, stating with reference to the Council's application to borrow £32,000 for the purposes of electric lighting, that in view of the early expiration of the electric lighting license of 1889, the board would not be in a position to sanction the loan for any period longer than the unexpired term of that license. If, however, the Council were desirous of carrying out the scheme by means of borrowed money, the matter must stand over until the Council were in a position to show that they have obtained new powers extending over a corresponding period. The Chairman and Clerk were appointed to wait upon the secretary of the Local Government Board for more information.

**Yeadon.**—The canvass made regarding the electric lighting question resulted in the return of 263 papers, 154 of which were blank, 76 against the adoption and 33 favourable toward it, and expressing intention of taking up 172 lights. The result is considered as decidedly unfavourable, and the Council will again bring the matter before a ratepayer's meeting.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

**An Electric Ventilating Plant.**—A new ventilating plant has lately been put down at the Rammelt pit of the Gerhard Stone Coal Mining Company, at Luisenthal. The plant is interesting, as being the first in the Saarbrucken district of Germany to be operated by electricity.

**Brighton—Rottingdean Seashore Railway.**—It is stated that the Brighton General Purposes Committee intends to ask the Town Council to oppose the Bills to be introduced into Parliament with reference to the Brighton and Rottingdean Seashore Electric Tramroad and Marine Palace and Pier. The *Brighton Guardian* presumes the committee is merely recording its formal objection to minor provisions in the Bills.

**Coventry Tramways.**—Boxing Day was a very busy time with the Coventry electrical tramways, 7,374 passengers being carried, and £41 taken in fares. Workmen's and scholars' tickets are issued.

**Electric Fans.**—The Admiralty is to experiment with electric fans for ventilating warships. The cruiser, *Pearl*, at Devonport, is to be first fitted, and if satisfactory, the *Phœbe* and *Philomel*, on the Cape Station, will be similarly fitted.

**Electric Traction in Austria.**—Application has been made for a concession for the construction of a narrow gauge electric railway between Tratenau, Freiheit, Marschendorf, Dunkelthal and Johannesbad.

**Electric Boring Plant in Austria.**—An electric boring plant is being installed at the State salt mines at Hallein. The plant, which is being supplied by Messrs. Siemens & Halske, will comprise a high pressure turbine coupled direct to a continuous current dynamo, and two boring machines.

**Electric Traction in Germany.**—The construction of an electric tramway between Leipzig and Halle is contemplated. The tramway at Wurzburg is to be converted into an electric line on the Siemens & Halske system. The horse tramways at Dantzig are also to be converted into electric lines. The necessary permission has been secured for the construction of an electric tramway between Eisenach and Marienthal. An electric tramway is also to be constructed between Elbing and Vogelsang.

**Electric Haulage on Canals.**—Some trials were carried out a few days ago on the Bourgogne Canal, at Dijon, with a new system of electric haulage and propulsion invented by M. Tilliot, the engineer to the canal company. The trials were entirely successful, the hauling apparatus being shown to be capable of hauling two barges, each loaded up to 200 tons, at a minimum speed of 2 kilometres per hour.

**Electric Traction in Russia.**—It is reported that plans are being prepared for the construction of a network of electric tramways in the town of Riga.

**Electric Traction in Italy.**—A proposal to establish an electric tramway at Perugia is under consideration. A line between Varese and Luino, a distance of 24 kilometres, is also projected. The Società Romani degli Omnibus is contemplating the conversion of the whole of its horse tramways in Rome into electric lines.

**Glasgow Tramways.**—"Glasgow and its Tramway System" is the title of a series of articles appearing in the *Glasgow Herald*. The first of the series, which appeared on January 2nd, is smartly written; the opening paragraphs are tinted with faint humour, and are immediately followed by stubborn facts regarding existing electric and cable systems, and schemes now under consideration. The article, taken generally, would appear to come from a well-informed source, but a slight slip has been made regarding the Bristol Tramways, which are stated to have been opened "last month," instead of October last, as our readers will remember. The writer seems at present well balanced between electric and cable traction, and he has not expressed any definite opinion either way. Probably this will come with the final article, if the author attempts to draw conclusions.

**Leeds Tramways.**—Dr. Hopkinson, we learn, has recommended the Leeds Corporation to adopt the Westinghouse electro-magnetic system of traction in those parts of the town where overhead wires and poles would be considered objectionable.

**Light Railways in Wales.**—The *Western Mail* has been taking the views of prominent men in that part of the United Kingdom on the question of the light railways proposed for West Wales. Mr. Charles Lloyd, J.P., a landed proprietor, suggests that in the scheme proposed by Mr. Morgan Richardson, an important omission is made, *i.e.*, that the system should be connected with some second large railway system of the United Kingdom. He considers that to bring two of the great railway systems into competition should be the promoters' first object. He suggests a connection with the London and North-Western Railway.

**Sheffield Tramways.**—The solicitors to the Sheffield District and Rotherham Tramways Company are asking the Corporation for a lease for the existing tramways for 28 years. The system the company propose to adopt is that of overhead electric traction.

**The Proposed Tramways from Derby to Ashbourne.**—The Bill to incorporate a company for the construction of tramways from Derby to Ashbourne has been duly deposited for next session. The promoters named in the Bill are Sir Henry Wilmot, Bart., V.C., C.B., the Hon. Frederick Strutt, Mr. Alfred Charles Duncombe, Mr. Godfrey Franceys Meynell, and Mr. John Shaw. The capital proposed to be raised by this company is £70,000, divided into 7,000 shares of £10 each. Borrowing powers are also sought to be exercised by mortgages upon the undertaking to an extent not exceeding £17,500. The time sought for the construction of this tramway is five years from the passing of the Act, during which period it is proposed to pay interest out of capital to an extent not exceeding £10,000.

## TELEGRAPH AND TELEPHONE NOTES.

**Australian Landline again Interrupted.**—It is only a fortnight since we had occasion to call attention to an interruption of the Western Australian landline, which joins the cable at Roebuck Bay. We then referred to the frequency of these landline interruptions which prevent the submarine cable above referred to from being considered a reliable alternative to the Port Darwin route. From the Australian Press we now learn that still another interruption has occurred to the westward of Israelite Bay, the line becoming useless on November 23rd, after having been working for about a fortnight. We also learn that "very heavy thunderstorms are raging along the line, west of Eucla." This goes far to confirm the statement made to the Ottawa Conference by Mr. Playford, the delegate from South Australia, who said: "Our line takes the whole of the messages; it is an easier line to work, running through the Continent from north to south, whereas the other runs along the coast, and is more liable to be interrupted by thunderstorms and atmospheric causes" Under these conditions this line cannot be considered as a satisfactory alternative route; although for purposes of argument against the laying of the Pacific cable, it has frequently been described as such. The importance of efficient telegraph service has been brought very forcibly home to the public by the delays at present experienced in getting intelligence from the Transvaal. It also calls for remark, that although Western Australia has belonged to the International Telegraph Union, since 1894, it appears that the Bureau International des Administrations Télégraphiques at Berne has not been kept advised of the occurrence of the interruptions of which we complain. This is *not* in accordance with Article lxxxii., Clause 4, of the International Telegraph Convention, which reads: "In addition to this, the said administrations send to that office, by telegraph, notice of all interruptions and restorations of communication affecting international traffic."

**A Lesson of the Moment.**—Writing to the *Times*, Sir George Baden-Powell says:—"At the moment we are all of us painfully anxious for prompt and unadulterated telegraphic news from South Africa, from Venezuela, and from other places where there is trouble. Still greater would be our anxiety and our need in time of actual war. The public will do well to bear in mind the present condition of our telegraphic connections. In regard to South Africa, the Aden-Zanzibar cable happens to have broken at an inopportune

moment; considerable delay occurs on the West Coast route. But all these messages, as well as those to and from the Ashanti expedition, have to pass through foreign territory. Again, telegraphic connection with British Guiana, with all our West Indian possessions, with our fleet in the West Indies, is maintained by means of land-lines across Cuba and across the United States—lines subject to the necessities of local combatants or others who might be hostile to us. The remedy is simple, viz., to hasten the inevitable completion of two projected all-British direct cables. It is an axiom of to-day that submarine cables, made and laid with all the latest appliances, are certain to pay for commercial purposes; for State and strategic purposes they are indispensable. It is therefore to be hoped that in these moments of stress the public will read the lesson aright, and see to it that the responsible authorities arrange to provide the two lines of cable communication which our Empire may so urgently need in the future, viz., the shorter line from Bermuda to Jamaica and the longer line from Vancouver to Australia, with its continuation to Mauritius and South Africa. We shall thus obtain alternative and all-British means of communicating between all over-sea points of the Empire, invaluable alike for the commerce and security of all its parts."

**Divided Duties.**—Last week we printed a letter signed jointly by the secretary of the Western and Brazilian Telegraph Company and the secretary of the Brazilian Submarine Telegraph Company, both of which companies appear, for the moment, to have sunk their differences regarding Trinidad Island, in view of the publication of a statement concerning the time occupied by telegrams in transit over their lines from London to Buenos Ayres. As to the accuracy of the figures in question, we are not in a position to speak; this is a matter with which the advocates of the two routes in question—viz., the line *via* Galveston and the Lisbon-Madeira route—are best qualified to deal. The point which appears to us of most interest is that Sir John Pender is the chairman of several telegraph companies, amongst others, the Eastern Telegraph Company, the Brazilian Submarine Telegraph Company, and the Direct United States Telegraph Company. Now, it is to the interest of the shareholders in each of these companies that the management of each should secure as much traffic as possible for their respective lines. But a telegram from England, which is sent *via* Lisbon and Madeira to Buenos Ayres, has not that pecuniary interest for the shareholders of the Direct United States Company (a partner in the Anglo "pool") as it might have if the same telegram were sent across the Atlantic to join the Galveston route; while, on the other hand, a telegram sent *via* Galveston is of no advantage to either the Eastern Telegraph Company or to the Brazilian Submarine Telegraph Company. What steps does Sir John Pender, as chairman of these competing companies, take to reconcile the interests which are so directly opposed to each other?

**A New South American Cable.**—The *Review of the River Plate*, referring to the proposed new cable southwards from Buenos Ayres, says:—"A new concession that has been applied for will fill a greatly felt want in this country, and it is to be hoped that the proposal is something better than a wild-cat one. It is to establish a submarine cable, which, starting from Monte Video, shall cross to Buenos Ayres, and then pass down the coast of the Argentine Republic to Santa Cruz, from which point it is intended that it shall strike across to the Falkland Islands. The present Government appear to be waking up to the fact that vast tracts of this country still remain closed, principally through the supineness of the rulers. They are about to open up Neuquen; the news from Chubut, which a colleague, written in English, has transmitted to General Roca, may, perhaps, cause their fostering care to be directed thither. They are reported to be considering whether it is just and right that Terra del Fuego should be the happy hunting ground of monopolists and backstairs politicians; and if they give their sanction, and that of the Legislature is given to this proposal for a cable, Patagonia may, perhaps, attract the attention of those settlers who turn away in fear from the United States. But we are greatly afraid that the commercial success of such a scheme is hardly doubtful."

**Telegraphs in Siam.**—An Indian exchange says that the head of the Siamese Public Works Department has left Bankok for Tavoy to inquire into the constant telegraphic interruptions between Burmah and Siam, and to make arrangements for improving the maintenance of the line.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Austria.**—March 1st. The Municipal Authorities of Brünn are inviting tenders for the establishment of a central station in the town for the generation and supply of electrical energy for lighting and power purposes, including that necessary for an electric tramway. Tenders to be sent to the Burgermeisteramt der Landeshauprstadt, Brünn, Austria.

**Belgium.**—January 15th, 1896. The Belgian Minister of War is inviting tenders for the contract for an installation of electric lighting in the new military school in the Avenue de la Renaissance in Brussels. Tenders to the Ministère de la Guerre, Brussels.

**Brazil.**—January 25th, 1896. The Minister of Industry of the State of Pernambuco is inviting schemes for the electric lighting of the town of Recife in that State.

**Germany.**—January 16th. Tenders are being invited by the Erfurt Direction of the Prussian State Railways for the supply of 500 telegraph poles. Tenders to be directed to the Königliche Eisenbahn Direction, 23, Bahnhofsstrasse, Erfurt, Germany.

**Germany.**—January 29th. Tenders are being invited by the Kattowitz Direction of the Prussian State Railways for the supply of a quantity of arc lamp carbons required for electric lighting purposes on the Kattowitz section of the State Railways. Tenders to be sent to the Königliche Eisenbahn Direction, Kattowitz, Germany.

**London.**—January 16th. The Vestry of St. Pancras is inviting tenders for wiring and fitting the Vestry Hall and offices for electric lighting. Details from the Electricity Department Offices, 57, Pratt Street, N.W.

**Roumania.**—January 15th. The municipal authorities of Ploesci, Roumania, are inviting tenders for the concession for lighting 46 of the principal streets of the town by electricity. Tenders to be sent to La Mairie, a Ploesci, Roumania.

**Roumania.**—January 23rd. The Roumanian State Railway authorities are inviting tenders for the supply of 60,000 rolls of paper for the use of the telegraph service, Tenders to the Chemin de Fer de l'Etat Roumain, at Bucharet, Roumania.

**Spain.**—The municipal authorities of Burriana (Castellon province) are at present inviting tenders for the electric lighting of the town during a period of 10 years. Tenders to the Secretario, del Ayuntamiento de Burriana (Castellon).

**Shoreditch.**—January 20th. The Vestry of St. Leonard, Shoreditch, are asking for tenders for the supply and erection of buildings for the electric lighting station and dust destructors. Tenders to be in by the 20th inst. Particulars from the engineers, Messrs. Kincaid, Waller and Manville, 29, Great George Street, S.W.

### CLOSED.

**Coventry.**—The Council has sealed the contract with the Coventry Electrical Engineering Company for electrically lighting the Free Library for £140.

**Loughborough.**—We understand that the Council has accepted (subject) a tender for electrical plant sent in by the Brush Company.

**London.**—The tender of Messrs. F. A. Glover & Co. for the electric lighting of the Agricultural Hall has been accepted. Beside incandescent lighting, there are to be 45 arc lamps, together with large mains for supplying current for the various exhibitions.

## NOTES.

**The Walsall Electric Lighting Station.**—We made a serious omission in our description of the Walsall Electric Lighting Station last week, and that was that Messrs. T. Parker, Limited, designed, made and put down the whole of the generating plant and switching apparatus.

**Electronite.**—What a pity it is that such an old-established and intelligent firm as Messrs. Curtis & Harvey, a firm dear to all sporting electricians, should take the trouble to rack their brains for a name for their new blasting explosive, and yet succeed no better than in coining such a crass misnomer as *electronite*. It is a name which cannot be defended on philological grounds, for it outrages the principles upon which philologists depend when anglicising Greek or other dead languages; and it is a name which, in virtue of its meaninglessness, rather insults the intelligence of the mining engineers who are destined to use it. To drag in some reference to electricity in order to attract attention to a new commodity, is to follow the tactics of the quacks, who imagine—or, rather, used to imagine (some of them have been cured of these vain imaginings lately)—that the vulgar mind is thereby impressed. Surely the mining engineers who are the customers of Messrs. Curtis & Harvey for this misnamed powder are too familiar with electricity and its applications to lighting, traction, haulage, fuse-firing, rock-boring, &c., to be in any way appealed to by such a designation for the new powder as *electronite!*

**Steam, Electricity and Sobriety.**—When the future historian comes to write the history of the times we are now living in, he will doubtless largely attribute the rapid march of civilisation in the nineteenth century to the developments of steam and electricity. If he should be a John Richard Green, we may be certain that he will endeavour to describe our virtues, vices, habits, customs, &c., to mark their development, and to trace the conditions which governed them. As regards one aspect of present human habits, Miss Willard, the well known temperance reformer, has anticipated the future historian. In a recent address upon the progress of the temperance movement, she said that "men who drink liquor take less of it, and that more men do not drink at all than in any previous year;" and she explained this by saying that the general advancement in industrial and scientific matters had an elevating tendency upon men's minds. "Steam and electricity, machinery and invention, have put level heads at a premium." We do not know whether the first part of Miss Willard's statement could be sustained by statistics, but we are flattered with the latter; for it has never occurred to us to claim that electricity is making men more sober. However, reflection will certainly support this view, for the development of our industry has called for more men with clear heads, upon whom may be reposed responsibility for life and property, and for more men with steady hands, upon whom may be devolved the work of construction and operation with precision. Of course, many other conditions have conduced to sobriety; but even the intemperate temperance orator will probably agree that amongst the great employers of labour, especially those who depend upon steam, electric, and other forms of mechanical installations, a discrimination is exercised against men of drinking habits. And thus the great Darwinian principle finds a new exposition: "for the fittest will only survive."

---

**The Keely Motor Again.**—Has Mr. Astor invested in the Keely motor? Such is the question which our contemporary, the New York *Electrical Review*, propounds to its readers. The *raison d'être* of this question appears to be based upon the observation that Mr. Astor has recently paid several visits to the building which John W. Keely, of Philadelphia, calls his "laboratory," and also upon the report—which has neither been affirmed nor denied by Mr. Astor—that he has purchased all the rights, interests, and stock of Mrs. Bloomfield Moore in the Keely motor. The evidence is, therefore, not very convincing; but if it be the truth, we congratulate Mrs. Moore, who is believed to have spent quite a fortune over the man Keely, and to have admitted that in spite of the vast sums of money with which he has been supplied during the past 20 years by the Keely Motor Company, and by private individuals, he has never yet invented any commercial engine. Though Mr. Astor can doubtless afford to lose in the gratification of any passing whim, we should be sorry to be assured of the truth of the statement which has been made current about him. We have demonstrated again and again that Keely is trading in mere fancies, and that he only succeeds in talking gibberish when he attempts to explain what he has been about these last 20 years or more. If only the money which has been wasted over this man had been expended in endowing genuine research, something useful to the whole industrial and scientific world would, without doubt, have been the outcome; for every research carried completely through enriches the store of human knowledge. As for Keely, we cannot resist the temptation of summing him up with the old Latin dictum, *Ex nihilo nihil fit.*

---

**A Wide Patent.**—No doubt many of our readers noticed under "New Patents" in our issue dated December 13th, 1895, the following:—

22,976. "Improvements connected with electric telegraphs, organs, condensers, deposition of nickel and cobalt, and with packing eggs and other fragile articles, and coating eyelets and such objects, and making bleaching powder." J. SWINBURNE. Dated November 30th, 1895.

We did not know it was Mr. Swinburne's rule to put all his eggs into one basket.

---

**Artesian Well Boring.**—Our Australian correspondent writes as follows:—Your article on artesian wells in your issue of October 11th, reminded me that a great deal has been done by the New South Wales Government in the direction of boring artesian wells, principally in the back-blocks in the Western and North-Western districts, covering a very wide area, and I enclose a list of the principal wells, most of which show a good pressure. At present none of them are used for power producing purposes, but the question has been mooted, especially with regard to the Moree bore, where it is estimated that about 140 horse-power is available.

LIST OF PRINCIPAL FLOWING WELLS OF N.S.W. GOVERNMENT.

| Bore. | Road. | Flow in gallons per day. | Pressure to square inch. |
|---|---|---|---|
| Moree .. .. | Moree .. .. .. .. | 3,000,000 | 96 lbs. |
| Clifton .. .. | Wanaaring to Milparinka .. | 2,000,000 | 45 lbs. (probably more). |
| Coonamble .. | Coonamble .. .. .. | 1,878,000 | 85 lbs. |
| Bourbah .. .. | Near Bourbah .. .. .. | 1,134,000 | Not gauged. |
| Moongulla .. .. | Collarendabri to Angledool .. | 850,000 | Do. |
| Dungle Ridge .. | Do. do. do. .. | 850,000 | Do. |
| Kerribree Creek .. | Bourke to Hungerford .. | 800,000 | 92 lbs. |
| Sibraas .. .. | Do. Wanaaring .. | 700,000 | 75 lbs. |
| Pera .. .. | Do. do. .. | 610,000 | 58 lbs. |
| Kelly's Camp .. | Do. Hungerford .. | 600,000 | 78 lbs. |
| Native Dog .. | Do. Barringun .. .. | 500,000 | 12 lbs. |
| Wanaaring .. | Wanaaring .. .. .. | 350,000 | Not gauged. |
| Osacca .. .. | Wanaaring to Milparinka .. | 350,000 | Do. |
| Eugonnia .. .. | Bourke to Barringun .. .. | 320,000 | Do. |
| Balalia .. .. | Do. do. .. .. | 400,000 | Do. |
| Walkdens .. .. | Do. Hungerford .. | 200,000 | 62 lbs. |
| Barrona .. .. | Louth to Wanaaring .. .. | 200,000 | Not gauged. |
| Barringun .. .. | Bourke to Barringun .. .. | 170,000 | Not shut down. |
| Gil-Gil .. .. | Moree to Boggabilla .. .. | 150,000 | Not gauged. |
| Brigalow .. .. | Ladknapper to Culgoa River | 150,000 | Do. |
| Dolgelly .. .. | Moree to Boggabilla .. .. | 100,000 | Do. |
| Youngerrina .. | Bourke to Hungerford .. | 120,000 | 20 lbs. |

---

**Mr. Trotter's Well-Wishers.**—In our issue of December 6th, we stated that Mr. A. P. Trotter was about to take up his residence at the Cape, so a complimentary dinner was given to that gentleman at the Whitehall Club, on Monday evening last, by some of his friends, Dr. John Hopkinson being in the chair. The table was laid for 30, and letters were received from about the same number, expressing their regret at not being able to be present to wish Mr. Trotter success in person. Mr. Trotter's friends presented him, on the occasion, with a gold watch, and the chairman stated that there would also be some present for Mrs. Trotter. The following were either present, or sent letters of regret:—Dr. J. Hopkinson, M.A., F.R.S. (in the chair), W. Beaumont, Sir Thomas Blomefield, Bart., W. Bond, R. E. Crompton, M.Inst.C.E., H. Edmunds, R. S. Erskine (hon. sec.), Prof. Forbes, M.A., F.R.S., T. E. Gatehouse, H. E. Harrison, Prof. Hughes, F.R.S., E. Manville, A. E. Mavor, W. M. Mordey, Prof. Perry, D.L., F.R.S., W. H. Preece, C.B., F.R.S., M.Inst.C.E., J. S. Raworth, R. P. Sellon, J. Swinburne, A. A. C. Swinton, F. H. Webb, Major-General Webber, C.B., M.Inst.C.E., Prof. Kennedy, Prof. Ayrton, A. H. Preece, Mark Robinson, G. P. Simpson (to represent Mr. Alexander Siemens), Sydney Morse, H. Burstall, Sir David Salomons, J. W. Swan, R. K. Gray, Major Cardew, W. T. Goolden, J. W. Holmes, L. W. Holmes, Lord Kelvin, B. Blount, J. Laister, Prof. Boyes, W. Geipel, E. Garcke, Sir F. Bramwell, Holroyd Smith, Musgrave Heaphy, W. L. Madgen, E. T. Carter, G. Binswanger, M. Binswanger, N. Hirst, J. M. Gorham, Reg. Wallis-Jones, Thomas Parker, S. Z. de Ferranti, J. H. Rosenthal, W. Slingo, G. Addenbrooke, N. Earle, Prof. Grylls Adams. We again offer Mr. Trotter our hearty good wishes in his new sphere of action.

---

**Avoidable Trolley Accidents.**—The recent disgraceful catastrophe at the open draw-bridge in Cleveland, when a trolley car plunged with its helpless load of passengers into the icy Cuyahoga, is now paralleled, says the New York *Electrical Engineer*, by an equally avoidable and hardly less disastrous accident between Paterson and Rutherford, N.J., when motormen trying to "steal switches" or right of way in the fog brought their cars together on an incline, killing one person outright and injuring several others. These accidents are wholly preventable. They should not happen, and the men who with human life entrusted to them take such chances should find that they will be visited with the heaviest and most extreme penalty the law inflicts. To deal leniently with these offences is to invite further accidents of the same nature. If the management exerts any pressure on its men to make such desperately foolhardy attempts, it should be punished with the same rigour.

**Telegraph Interruptions in Cables to South Africa.**—The following give particulars of interruptions of the various sections of the Eastern and South African Telegraph Company's cables which unite Aden with South Africa. The interruptions have all occurred since 1890 :—

| Interrupted. | Section. | Repaired. |
|---|---|---|
| 8/1/90 | Aden-Zanzibar ... ... ... | 10/1/90 |
| 11/5/91 | " " ... ... ... | 20/5/91 |
| 5/12/91 | " " ... ... ... | 28/12/91 |
| .. .. | " " ... ... ... | 10/9/93 |
| 20/2/93 | " " ... ... ... | 25/2/93 |
| 9/8/93 | " " ... ... ... | 9/10/93 |
| 21/12/94 | " " ... ... ... | 10/1/95 |
| 2/9/95 | " " ... ... ... | 1/10/95 |
| 24/12/95 | " " ... ... ... | 4/1/96 |
| 26/9/94 | Zanzibar-Mozambique ... ... | 22/1/95 |
| 11/11/90 | Mozambique-Delagoa Bay ... ... | 11/11/90 |
| 18/11/90 | " " ... ... | 19/11/90 |
| 5/1/93 | " " ... ... | 12/1/93 |
| 25/1/93 | " " ... ... | 27/1/93 |
| 9/6/95 | " " ... ... | 17/6/95 |
| 15/10/90 | Delagoa Bay-Natal ... ... ... | 15/10/90 |
| 10/12/94 | " " ... ... ... | 22/12/94 |

**Exhibitions Abroad.**—The Science and Art Department has received through the Foreign Office a communication stating that an International Exhibition will be held in Brussels in 1897. The Department has also received notice through the Foreign Office, from Her Majesty's Consul at Barcelona, that it is proposed to hold a Fine Art and Industrial Exhibition in that city, commencing on April 23rd next.

**Obituary.**—It is with regret that we record the death, which occurred on Tuesday morning, of Sir Julian Goldsmid, Bart., M.P. He was chairman of the Submarine Telegraph Company prior to its dissolution, and was also connected with gas and railway companies. He was made a Privy Councillor at the beginning of the present year. Sir Julian was 58 years of age.

**The Institution of Electrical Engineers.**—On Thursday, January 16th, 1896, the ordinary general meeting will be held, at 8 p.m., when presentation of premiums will be made, and the Inaugural Address of the President, Dr. John Hopkinson, M.A., F.R.S., will be given.

**Communication with the Transvaal.**—A Berne telegram of the 8th advises us that "Delay on private and press messages between Europe and South Africa is reduced to 24 hours."

**The Institution of Junior Engineers.**—A course of six lectures on "Marine Engineering Design" is to be delivered in February, March and April at Westminster Palace Hotel.

## NEW COMPANY REGISTERED.

**Langhans-Berrenberg-Chaplin Patents, Limited** (46,428).—This company was registered on December 31st with a capital of £175,000 in £1 shares, to enter into an agreement with A. M. Gibson, and to carry on the business of manufacturers of and dealers in incandescent and other electric lamps, electricians, mechanical engineers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with one share each) are:—H. L. Pilkington, 76, Jermyn Street, S.W., gentleman; P. J. Miller, 3, Pope's Head Alley, E.C, solicitor; T. L. Down, 3, Pope's Head Alley, E.C., solicitor; W. A. Smithe, 6, Old Jewry, E.C, bank director; D. S Porteous, 23, Eccleston Square, S.W., gentleman; A. da Costa, 16, Hyde Park Gate, S.W., gentleman; W. Wallace, 27, Old Broad Street, E.C., architect. Registered without articles of association. Registered office, 3, Pope's Head Alley, E.C.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Automatic Electric Sign Company, Limited** (44,685).—This company filed its statutory return on November 27th, when 158 shares were taken up out of a capital of £5,000, in £1 shares. £1 per share has been called, and £108 15s. paid, leaving £49 5s. outstanding.

**Railway Automatic Electric Light Syndicate, Limited** (28,332).—This company has just filed its annual return, which shows that out of a capital of £25,000, in £25 shares (400 ordinary and 600 preference), 396 ordinary and 586 preference have been taken up. 200 ordinary have been issued as paid, and the full amount has been called on the others. £18,408 has been paid, and £1,142 remains to come in, while £95 has been paid on 18 forfeited shares.

**Atlas Carbon Manufacturing Company, Limited** (34,857).—This company filed its last return on December 5th, when the whole capital of £2,000, in £1 shares, was taken up; 1,992 of these were issued as paid, and nothing has been called on the rest. The name has since been changed to the Atlas Carbon and Battery Company, Limited.

**Arc Accumulator Company, Limited** (34,015).—This company's last return was filed on December 11th, when the whole capital of £1,000, in £1 shares, was taken up; £993 have been issued as paid, and £1 per share called and paid on the other seven.

**African Trans-Continental Telegraph Company, Limited** (37,855).—This company's annual return, filed on December 31st, shows that the whole capital of £140,000, in £1 shares, has been taken up; £1 per share has been called on 1,306, and 10s. per share on the others, and £53,201 has been paid, leaving £17,537 outstanding.

**Brush Electrical Engineering Company, Limited** (29,533).—This company filed its last return on December 3rd. The capital is £750,000, in 150,000 £3 ordinary and 150,000 £2 preference shares; 90,000 of each class have been taken up, the full amount has been called, and £450,000 has been paid.

**Town and Village Electric Light and Power Company, Limited** (44,421).—This company's statutory return was filed on November 14th, when only seven shares were taken up out of a capital of £100,000, divided into 19,800 £5 ordinary and 1,000 £1 founders' shares. No calls have been made.

**Val D'Aosta Electric Power Company, Limited** (44,205).—This company filed its statutory return on November 15th, when 250 shares were taken up out of a capital of £80,000 in £10 shares. £5 per share has been called and £1,250 paid.

**Electro-Chemical Company, Limited** (40,496).—This company's annual return was filed on November 29th. The capital is £200,000, in £5 shares (26,000 preference). 17,710 preference and 14,000 ordinary have been taken up, and 5,000 preference and all the ordinary have been issued as paid. £4 per share has been called on the other preference, and £50,699 has been paid, while £141 is in arrears.

## CITY NOTES.

**The Direct United States Cable Company, Limited.**—The board have resolved upon the payment of an interim dividend of 2s. per share, free of income-tax, being at the rate of 2 per cent. per annum, for the quarter ending December 31st, 1895; such dividend to be payable on and after the 24th inst., setting aside £10,000 to reserve fund account, and carrying forward a balance of £4,148 14s. 4d.

**Stock Exchange Notices.**—Application has been made to the Stock Exchange Committee to allow to be quoted in the Official List: City and South London Railway Company—Further issue of 469 5 per cent. perpetual preference shares, Nos. 7,651 to 8,119, and St. James's and Pall Mall Electric Light Company, Limited—£50,000 4 per cent. debenture stock.

**Globe Telegraph and Trust.**—An interim dividend of 1s. 6d. per share has been declared by the directors, payable on the 20th inst.

**Eastern Extension, Australasia and China Telegraph Company, Limited.**—The interest on the 4 per cent. mortgage debenture stock for the half-year to January 31st will be paid on February 1st. The stock register will be closed from 28th to 31st inst., inclusive.

## TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending January 5th, 1896, were £1,017; week ending January 6th, 1895, £1,003; increase, £14; total receipts for half-year, 1896, £1,017; corresponding period, 1895, £1,003; increase, £14.

The Direct Spanish Telegraph Company. The receipts for the week ending December, 1895, amounted to £2,514; corresponding period, 1894, £1,671.

The Great Northern Telegraph Company. The traffic receipts in December, 1895, were £26,000; January 1st to December 31st, 1895, £312,400; corresponding months, 1894, £285,800; corresponding months, 1893, £269,200.

The Liverpool Overhead Railway Company. The receipts for the week ending January 5th, 1896, amounted to £1,150; corresponding week last year, £926; increase, £224.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 3rd, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,640.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present issue | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1892. | 1893. | 1894. | Closing Quotation Dec. 31st. | Closing Quotation, Jan. 8th. | Business done during week ended Jan. 8th, 1896. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 173,400£ | African Direct Teleg., Ltd., 4 % Deb. ... ... ... | 100 | ... | 4 % | 4 % | 101 —105 | 100 —104 | ... | |
| 1,912,880£ | Anglo-American Teleg., Ltd. ... ... ... ... ... | Stock | £2 15s. | £2 11s. | £2 2s. | 41 — 43 | 41 — 43 | 42⅛ | 41¼ |
| 2,993,560£ | Do. do. 6 % Pref. ... ... ... ... ... | Stock | £5 10s. | £5 2s. | £4 4s. | 79 — 81 | 79 — 81 | 80⅛ | 79½ |
| 2,993,560£ | Do. do. Defd. ... ... ... ... ... | Stock | ... | ... | ... | 6 — 6¼ | 5⅜ — 6¼ | 6⅜ | 5⅞ |
| 130,000 | Brazilian Submarine Teleg., Ltd. ... ... ... ... | 10 | 6½% § | 6½% § | ... | 13¼ — 13⅜ | 13¼ — 13⅜ | 13⅜ | 13⅜ |
| 75,000£ | Do. do. 5 %, Debs., 2nd series, 1906 ... ... | 100 | 5 % | 5 % | ... | 110 —114 | 110 —114 | ... | ... |
| 44,000 | Chili Telep., Ltd., Nos. 1 to 44,000 ... ... ... | 5 | 10%‖ § | ... § | 2½% | 3¼ — 3⅜ | 3¼ — 3⅜ | ... | ... |
| 10,000,000$ | Commercial Cable Co. ... ... ... ... ... ... | $100 | 7 % | 7 % | 7 % | 160 —170 | 160 —170 | ... | ... |
| 224,850 | Consolidated Telep. Const. and Main., Ltd. ... ... | 10/- | 2 % § | 2 % § | 1½% | ⅛ — ⅜ | ⅛ — ⅜ | ... | ... |
| 16,000 | Cuba Teleg., Ltd. ... ... ... ... ... ... | 10 | 8 % | 8 % | 8 % | 13 — 14 | 13 — 14 | ... | ... |
| 6,000 | Do. 10 % Pref. ... ... ... ... ... | 10 | 10 % | 10 % | 10 % | 20½ — 21½ | 20½ — 21½ | ... | ... |
| 12,931 | Direct Spanish Teleg., Ltd. ... ... ... ... ... | 5 | 4 % | 4 % | 4 % | 3½ — 4½ | 3½ — 4½ | 4¼ | ... |
| 6,000 | Do. do. 10 % Cum. Pref. ... ... ... | 5 | 10 % | 10 % | 10 % | 10 — 10½ | 10 — 10½ | ... | ... |
| 30,000£ | Do. do. 4½ % Debs. Nos. 1 to 6,000 ... | 50 | ... | ... | 4½% | 102 —105%xd | 102 —106%xd | ... | ... |
| 60,710 | Direct United States Cable, Ltd. ... ... ... ... | 20 | 3½% § | 2⅝% § | 2 % | 8 — 8½ | 8 — 8½ | 8⅛ | 8⅛ |
| 400,000 | Eastern Teleg., Ltd., Nos. 1 to 400,000 .. ... ... | 10 | 6½% § | 6½% § | 6½% | 16 — 16½ | 16 — 16½ | 16⅝ | 16 |
| 70,000 | Do. 6 % Cum. Pref. ... ... ... ... | 10 | 6 % § | 6 % § | 6 % | 17½ — 18 | 17½ — 18 | 17⅞ | ... |
| 102,100£ | Do. 5 % Debs., repay. August, 1899 ... ... | 100 | 5 % | 5 % | 5 % | 107 —110 | 107 —110 | ... | ... |
| 1,297,837£ | Do. 4 % Mort. Deb. Stock Red. ... ... | Stock | 4 % | 4 % | 4 % | 125 —128 | 125 —128 | ... | ... |
| 250,000 | Eastern Extension, Australasia and China Teleg., Ltd. ... | 10 | 7 % | 7 % | 7 % | 17 — 17½ | 17 — 17½ | 17½ | 17 |
| 54,100£ | Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 | 100 | 5 % | 5 % | 5 % | 102 —106 | 100 —104xd | ... | ... |
| 194,300£ | Do. do. Bearer, 1,050—3,975 and 4,327—6,400 | 100 | 5 % | 5 % | 5 % | 103 —106 | 101 —104xd | ... | ... |
| 320,000£ | Do. 4 % Deb. Stock ... ... ... ... ... | Stock | 4 % | 4 % | 4 % | 127 —130 | 127 —130 | ... | ... |
| 80,600£ | Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343 | 100 | 5 % | 5 % | 5 % | 102 —106 | 100 —104xd | 100½ | ... |
| 107,600£ | Do. do. do. to bearer, 2,344 to 5,500 | 100 | 5 % | 5 % | 5 % | 103 —106 | 101 —104 | 104 | ... |
| 300,000£ | Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909 | 100 | 4 % | 4 % | 4 % | 108 —111 | 107 —110 | 107 | ... |
| 200,000£ | Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | 4 % | 4 % | 4 % | 112 —115% | 112 —115 % | ... | ... |
| 180,227 | Globe Telegraph and Trust, Ltd. ... ... ... ... | 10 | 4⅞% § | 4⅝% § | 4⅛% | 9½ — 10 | 9½ — 10 | 9⅞ | 9½ |
| 180,042 | Do. do. 6 % Pref. ... ... ... | 10 | 6 % § | 6 % § | 6 % | 16½ — 17 | 16½ — 17 | 16⅞ | 16 9/16 |
| 150,000 | Great Northern Teleg. Company of Copenhagen ... ... | 10 | 8⅝% § | 8⅝% | 8⅝% | 21¾ — 22¼ | 21½ — 22 | ... | ... |
| 180,000£ | Do. do. do. 5 % Debs. | 100 | 5 % | 5 % | 5 % | 104 —107 | 104 —107 | ... | ... |
| 17,000 | Indo-European Teleg., Ltd. ... ... ... ... ... | 25 | 10 % | 10 % | 10 % | 46 — 49 | 46 — 49 | 48½ | 48½ |
| 100,000£ | London Platino-Brazilian Teleg., Ltd. 6 % Debs. ... ... | 100 | 6 % | 6 % | 6 % | 106 —110 | 106 —110 | ... | ... |
| 28,000 | Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ... | 5 | ... | ... | ... | 2 — 2½ | 2 — 2½ | ... | ... |
| 484,597 | National Teleph., Ltd., 1 to 484,597 ... ... ... ... | 5 | 5 % § | 5 % § | 5 % | 5⅞ — 6⅛ | 5⅞ — 6 | 6⅛ | 5⅞ |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 16 — 18 | 16 — 18 | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... | 10 | 6 % | 6 % | 6 % | 15½ — 16½ | 15½ — 16½ | ... | ... |
| 119,234 | Do. 5 % Non-cum. 3rd Pref., 1 to 119,234 | 5 | 5 % | 5 % | 5 % | 6¼ — 6½ | 6¼ — 6½ | ... | ... |
| 1,100,000£ | Do. 3½ % Deb. Stock Red. ... ... | Stock | 3½% | 3½% | 3½% | 105 —107 xd | 104 —107xd | 105½ | ... |
| 171,504 | Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid | 1 | ... | ... | 4¼% | 9/16 — 11/16 | 9/16 — 11/16 | ... | ... |
| 100,000£ | Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000 | 100 | 4 % | 4 % | 4 % | 108 — 111xd | 108 —111 | ... | ... |
| 11,839 | Reuter's Ltd. ... ... ... ... ... ... ... | 8 | 5 % | 0 % | *nil* | 4 — 5 | 4 — 5 | ... | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 127 —132 | 127 —132 | ... | ... |
| 58,000 | United River Plate Teleph., Ltd. ... ... ... ... | 5 | ... | ... | ... | 2½ — 3 | 2½ — 3 | ... | ... |
| 146,733£ | Do. do. 5 % Debs. ... ... ... | Stock | 5 % | 5 % | 5 % | 90 — 95 xd | 90 — 95 | ... | ... |
| 15,609 | West African Teleg., Ltd., 7,501 to 23,109 ... ... | 10 | ... | ... | *nil* | 5½ — 6½ | 5½ — 6½ | ... | ... |
| 238,300£ | Do. do. do. 5 % Debs. ... ... ... | 100 | 5 % | 5 % | 5 % | 102 —105 | 102 —105 | 102¼ | ... |
| 30,000 | West Coast of America Teleg., Ltd. ... ... ... ... | 10 | ... | ... | ... | 1 — 2 | 1 — 2 | ... | ... |
| 150,000£ | Do. do. do. 8 % Debs., repay. 1902 | 100 | 8 % | 8 % | ... | 94 — 99 xd | 94 — 99 | ... | ... |
| 64,248 | Western and Brazilian Teleg., Ltd. ... ... ... ... | 15 | 2½% | 2½% | 3 % | 9 — 9½ | 9 — 9½ | 9⅛ | ... |
| 33,129 | Do. do. do. 5 % Pref. Ord. ... | 7½ | 5 % | 5 % | 5 % | 6½ — 6⅝ | 6½ — 6⅝ | 6⅝ | ... |
| 33,129 | Do. do. do. Def. Ord. ... ... | 7½ | ... | ... | 1 % | 2⅜ — 3¼ | 2⅜ — 3¼ | ... | ... |
| 165,200£ | Do. do. do. 6 % Debs. "A," 1880 Red. | 100 | 6 % | 6 % | 6 % | 103 —107 | 103 —107 | ... | ... |
| 206,400£ | Do. do. do. do "B," do. | 100 | 6 % | 6 % | 6 % | 103 —107 | 103 —107 | ... | ... |
| 88,321 | West India and Panama Teleg., Ltd. ... ... ... | 10 | ⅛% | ⅛% | ⅛% | 7/16 — 1½ | 7/16 — 1½ | ... | ... |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 10¼ — 10⅜ | 10¼ — 10⅜ | 10½ | ... |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 8½ — 9½ | 8½ — 9½ | ... | ... |
| 80,000£ | Do. do. 5 % Debs. No. 1 to 1,800 ... | 100 | 5 % | 5 % | 5 % | 109 —112 xd | 109 —112xd | ... | ... |
| 1,777,000$ | Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ... | $1000 | 7 % | 7 % | 7 % | 113 —118 | 113 —118 | ... | ... |
| 164,300£ | Do. do. 6 % Ster. Bonds. ... ... | 100 | 6 % | 6 % | 6 % | 100 —103 | 100 —103 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | Charing Cross and Strand Electy. Supply ... ... ... | 5 | 5 % | 4½% | 4½% | 5¼ — 5⅜ | 5¼ — 5⅜ | ... | ... |
| 10,277 | *Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ... | 5 | 2½% | 5 % | 5 % | 6⅞ — 7¼ | 6⅞ — 7¼ | ... | ... |
| 60,000 | Do. do. do. 4½ % Deb. Stock Red. ... | Stock | ... | ... | ... | 116—118 xd | 115 — 118 | 115⅜ | ... |
| 40,000 | City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000 | 10 | ... | ... | 5 % | 12⅜ — 13¼ | 12⅜ — 13¼ | 13 3/16 | 12 15/16 |
| 40,000 | Do. do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | 6 % | 6 % | 15½ — 16 | 15½ — 16 | ... | ... |
| 300,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | 5 % | 5 % | 131 —135 xd | 131 —135 | 134½ | 132 |
| 22,475 | County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475 | 10 | ... | ... | ... | 8 — 9 | 8 — 9 | ... | ... |
| 10,000 | Do. do. do. 6% Pref., £8 pd., 40,001—50,000 | 10 | ... | ... | ... | 8½ — 9 | 10½ — 11 | ... | ... |
| 50,000 | †Liverpool Electric Supply, all paid ... ... ... ... | 5 | 5 % | 5 % | 5⅛% | 7⅞ — 8⅛ | 7⅞ — 8⅛ | ... | ... |
| 49,900 | *Metropolitan Electric Supply, Ltd., 101 to 50,000 ... | 10 | 2 % | 2½% | 3 % | 10 — 11 | 10 — 11 | 10½ | ... |
| 150,000£ | Do. 4½% first mortgage debenture stock ... ... | ... | 4½% | 4½% | ... | 115 —118 xd | 114 —117 | ... | ... |
| 6,452 | Notting Hill Electric Lightg. Co., Ltd. ... ... ... | 10 | ... | ... | 1 % | 8½ — 9 | 8½ — 9 | ... | ... |
| 19,980 | St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080 | 5 | 7½% | 4½% | 6½% | 8¼ — 8⅜ | 8¼ — 8⅜ | 8⅜ | ... |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 9 — 9⅛ | 9 — 9¼ | ... | ... |
| 67,900 | *Westminster Electric Supply Corp., Ord., 101 to 60,000 ... | 5 | 3½% | 4 % | 5 % | 8¼ — 8⅜ | 8¼ — 8⅜ | 8 3/16 | 8⅛ |

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1892. | 1893. | 1894. | Closing Quotation, Dec. 31st. | Closing Quotation, Jan. 8th. | Business done during week ended Jan. 8th, 1896. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 90,000 | Brush Elecl. Enging. Co., Ord., 1 to 90,000... ... ... | 3 | 6 % § | 6 % § | ... | 1⅛ — 1⅜ | 1⅛ — 1⅜ | ... | ... |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | 6 % § | 6 % § | ... | 1⅞ — 2⅛ | 1⅞ — 2 | ... | ... |
| 125,000*l* | Do. do. 4½ % Perp. Deb. Stock.... ... | Stock | 4½% | 4½% | ... | 112 —115 | 112 —115 | ... | ... |
| 630,000*l* | City and South London Railway ... ... ... ... | Stock | ⅝% | ⅝% | 1¼% | 40 — 42 | 40 — 42 | ... | ... |
| 28,180 | Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180 | 5 | 7 % § | 7 % § | ... | 2 — 2½ | 2 — 2½ | ... | ... |
| 89,261 | Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261 | 5 | ... | ... | 5 % | 1½ — 2 | 1½ — 2 | 1 13/16 | 1½ |
| 17,139 | Do. do. do. "A" Shares 01—017,139 | 5 | ... | ... | ... | 3 — 4 | 3 — 4 | ... | ... |
| 100,000 | Do. do. do. 4½% Deb. Stock Red. ... | Stock | ... | ... | 4½% | 104 —107 xd | 104 —107 | 104 | ... |
| 110,000 | Electric Construction, Ltd., 1 to 110,000 ... ... ... | 2 | *nil* | *nil* | *nil* | ⅝ — ⅞ | ⅝ — ⅞ | ... | ... |
| 12,845 | Do. do. 7 % Cum. Pref., 1 to 12,845 ... | 2 | 7 % | 7 % | 7 % | 2 — 2⅛ | 2 — 2⅛ | ... | ... |
| 91,195 | Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000 ... ... | 2 | *nil* | *nil* | ... | ¼ — ½ | ¼ — ½ | ... | ... |
| 69,385 | Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ... | 2 | *nil* | *nil* | ... | ⅜ — ⅝ | ⅜ — ⅝ | ... | ... |
| 20,000 | Fowler-Waring Cables, Nos. 301 to 20,300 ... ... ... | 5 | *nil* § | *nil* § | ... | ¼ — ⅝ | ¼ — ⅝ | .. | .. |
| 9,600*l* | Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ... | 10 | 7 % | *nil* | ... | 8 — 9 | 8 — 9 | .. | .. |
| 10,000 | Henley's (W. T.) Telegraph Works, Ltd., Ord. ... ... | 10 | 5 % | 5 % | 6 % | 13½ — 14½ | 13½ — 14½ | ... | ... |
| 3,000 | Do. do. do. 7% Pref. ... ... | 10 | ... | ... | ... | 15½ — 16½ | 15½ — 16½ | ... | ... |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock | Stock | .. | ... | ... | 108 —111 | 108 —111 | | ... |
| 50,000 | India-Rubber, Gutta Percha and Teleg. Works, Ltd. ... | 10 | 12½% | 12½% | 10 % | 18 — 19 | 18 — 19 | 19 | 18½ |
| 200,000*l* | Do. do. do. 4½ % Deb., 1896 | 100 | 4½% | 4½% | 4½% | 101 —103 | 101 —103 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | ... | 1 % | 1½% | 11⅛ — 11⅜ | 11⅛ — 11⅜ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | ... | 5 % | 5 % | 15½ — 15⅝ | 15½ — 15⅝ | .. | .. |
| 37,350 | Telegraph Constn. and Maintce., Ltd. ... ... ... | 12 | 15 % | 20 % | 20 % | 41 — 43 | 41 — 43 | 43 | 41½ |
| 150,000 | Do. do. do. 5 % Bonds, red. 1899 | 100 | 5 % | 5 % | 5 % | 104 —107 | 102 —105 xd | ... | ... |
| 54,000*l* | Waterloo and City Railway, Nos. 1 to 54,000, £4 paid ... | 10 | ... | ... | ... | 4⅜ — 5 | 4⅜ — 5 | 4⅜ | ... |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 189
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

**Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¾—6¼.**

**Electric Construction Corporation, 6 % Debentures, 95—100xd.**

**House-to-House Company (£5 paid), 3⅞—4¼.**

**Do. do. 7 % Preference, of £5, 7⅞—8¼.**

**Do. do. 4½% Debentures of £100, 110—112.**

**Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 7⅞—8¼; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.**

**Liverpool Electric Supply, £5 (fully paid), 7⅞—8¼.**

**London Electric Supply Corporation, £5 Ordinary, ⅜—⅝.**

**Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 6⅞—7¼.**

**Bank rate of discount 2 per cent. (February 22nd, 1894).**

## REVIEWS.

*Fisica Tecnologica: Elettricità e Magnetismo Nozioni fondamentali della Elettrotecnica illustrate da una compendiosa Esposizione delle principali Applicazioni nell, attrale loro Svilluppo.** By RINALDO FERRINI, Professor at the Higher Institution of Milan. Second edition, entirely re-written and illustrated with 169 figures. Milan: Ulrico Hoepli, 1896. 8vo., pp. 534.

Among the numerous important treatises on electricity, for which we are indebted to Italian authors, the volume before us may justly claim an honourable place.

In his preface, Prof. Ferrini objects to some of the names for electrotechnical units which have found their way into Italian, as well as into other European languages. He objects to the abridgments "volt" and "farad," and would write these names in full. For "impedance" he would substitute "impediment"; for "voltage," "electric pressure," and for "shunt," "derivation." It may, however, be asked, whether it is not advantageous to have a set of identical terms used and understood by electricians in all countries, analogous to the names of weights and measures which have been introduced everywhere along with the metric system, and which are more cumbrous than the electrotechnical terms in question?

The first chapter of the work treats of electrostatics, and gives an exposition of the subject, which will not encounter any objections.

The second chapter takes up continuous currents and electrolysis. Among the practical applications of electrolysis there are some of unquestionable value, and others of doubtful utility. It has latterly been observed that aluminium obtained by the electrolytic process is liable to contain an impurity of sodium which, though small in amount, renders the metal very unstable, and open to destructive action (*Comptes Rendus*, cxxi., p. 794).

Goppelsroedor's electric production of coal-tar colours has not yet come into use on a commercial scale. Hermite's treatment of sewage, which is certainly practicable in maritime localities, is open to one grave objection, the organic nitrogen, or "allumenoid ammonia," and the other nitrogen compounds, are either decomposed, or allowed to remain in a soluble state, and consequently unutilised. Now, the great desideratum in the treatment of sewage, is to obtain all the nitrogenous compounds in such a form that they may be applicable to the land. Whether the effluent water from Hermite's process can be advantageously used in irrigation is yet undecided.

That copper can be refined electrically in a satisfactory manner is unquestionable. To the value of the Elmore process (which is here mentioned) we need not refer.

In the same chapter we have an account of the primary couples and batteries of Clamond, Gülcher, Smee, Grove, Bunsen and Daniell. In the table of electro-chemical equivalents (p. 91) we find no mention of platinum, but on p. 116 is a more complete table of the specific resistances of metals and alloys.

In tabulating the electric units with their definitions, the author proposes a set of symbols, such as C for the coulomb, A for the ampere, O for the ohm, V for the volt, F for the farad, J for the joule, and W for the watt.

* Technological Physics: Electricity and Magnetism. The fundamental notions of electrotechnics illustrated in a compendious exposition of their principal applications.

The third chapter discusses magnetic induction. We find here an account of aperiodic and ballistic galvanometers, of the galvanometer of Arsonval, the solenoid amperemeter or ammeter, the electro-dynamometer, the thermic ammeter, the Carpentier electrometer, the Siemens and Cardew voltmeters, and the wattmeter.

The fourth chapter treats of induction currents, and the fifth is devoted to dynamos, motors, and what may be in great part called the mechanical applications of electricity. There is an account of electric motors, continuous and alternating, of polyphase motors, of the monophase motors of Brown, of Benisohke's asynchronous motor, and of transformers.

Electric lighting is duly considered, as is natural in a work written in a country so rich in water-power as is Italy. The experiments of Tesla are not overlooked; but it is remarked that the conditions for such illumination are as yet much less advantageous than is the case with ordinary electric lamps.

The question of protection against lightning the author rightly regards as requiring further study. The disaster to the Town Hall of Brussels, though fitted with conductors according to the Franklin principle, all in perfect order, is unpleasantly significant.

---

*Submarine Telegraphy and Other Papers.* By James Bell and S. Wilson. London: *Electricity*, 11, Ludgate H ill.

This book is a reprint of a series of papers which appeared in *Electricity*. The title is distinctly and most unjustifiably misleading, as the printing on the cover and title page in large type of "Submarine Telegraphy," and in small type of "And Other Papers," at once leads the purchaser to believe that he is obtaining a book dealing chiefly with submarine telegraphy, whereas but 11 pages, out of a total of 61, are devoted to the subject. We have no fault to find with the matter, such as it is, as a great deal of useful information is contained in the few pages. The changes are once more rung on the unfortunate Minotto cell, which has again a new spelling in the table of contents, being this time "Minnotto." The description of this cell is not particularly correct, it being stated that a disc of copper is placed at the bottom of a jar, "which is nearly filled with water." It is true that the use of sawdust or sand is afterwards referred to, but this is not the proper way to show how the cell is built up. Neither is it correct to say that the cells will work for nearly two years with very little attention. Again, it is not true to say that, in submarine cable working, the condensers are used to reduce to a minimum the retardation due to the inductive capacity of the cable; they actually increase the retardation.

In land line matters the writers are much more at home, and concerning which they write to much advantage. The "other papers" deal with "Condensers," "Concentrator Switch," "Theory of the Universal Battery System," "Theory of the Post Office Battery Testing Instrument, A," "Theory of the Tangent Galvanometer," "Additional Wheatstone Bridge Tests," "Theory of the Wheatstone Bridge," "Electric Lighting Units," "Mirror Galvanometer," "Post Office Battery Testing Instrument."

---

*The Electrical Transmission of Energy.* By A. V. Abbott. New York: Van Nostrand Company. London: Sampson, Low, Marston & Co.

This work, got up in the usual excellent American style, is compiled by the chief engineer of the Chicago Telephone Company. It is an attempt to collect and arrange in a convenient form the data necessary to the scientific designing and proportioning of electrical circuits. The work is written chiefly from an American point of view, and deals mostly with American practice, though English works have been drawn upon verbatim for certain classes of information, especially those relating to testing; the author, however, acknowledges his indebtedness to these works. The opening chapter shows briefly various arrangements of circuits for electrical distribution; a chapter then follows on the "Properties of Wire." This chapter is very full, and contains various tables of gauges, breaking strengths, &c., of wire of various kinds. Testing apparatus and specifications, both English and American, are also described. The construction of pole lines is purely American in character, and is instructive. Underground circuits receive a considerable share of attention, several English and Continental systems being illustrated and described. Various types of cables are also well illustrated. "Methods of Electrical Measurement," which follow, are largely drawn from well known English standard works. The chapter on "Conductors for Alternating Currents" is very full and well put together, and is distinctly a useful chapter. "Series" and "parallel" distribution are then thoroughly gone into, and the book concludes with a chapter on the "Cost of Production and Distribution." Altogether, the whole compilation is very creditable, attractive, and useful.

---

*Gleanings from Patent Laws of all Countries.* By W. Lloyd Wise. First portion. London: Cassell & Co., Limited.

This is a little work dealing with the Patent Laws of 22 of the 70 or 80 countries in which the system of granting patents for inventions obtains. The various countries are arranged alphabetically, and in the present volume, in addition to some of minor, there are several of considerable importance, including Austria, Belgium, France and Germany. Succinct but comprehensive information is given under the headings, "Application," "Procedure," "Grant," "Assignment and Transfer of Patents," "Government Fees," "Dates of Laws," "Kinds of Patents," "Subject Matter," "Term," "Who may Obtain a Patent," &c., and a feature which distinguishes the book from the generality of works on Patent Law is that relating to the productions and manufactures of the respective countries, particulars of which, especially in some instances, are given very fully, the object being, of course, to afford information to inventors as to what are and what are not likely to be profitable openings for the introduction of their particular inventions. Points of actual practice, and not merely the dry bones of law, are treated upon, the Government fees are indicated, and, as respects the more important countries, valuable information, with notes of actual decisions, is given as to what is and is not likely to be deemed sufficient compliance with the compulsory working sections of the various laws; which, by the way, it is to be wished were universally abolished, entailing as they do much hardship on patentees, in addition to ludicrously failing to achieve the object in view in framing them. The work is, we should think, likely to be much used as a book of reference.

---

*Theorie de L'Electricité.* By A. Vaschy. Paris: Baudry et Cie, 15, Rue des Saintes Pères.

Any work by M. Vaschy is welcome, and commands respect, and to students of the higher branches of electrical science, the work will prove of considerable value as a supplement to the works of Maxwell. There is rather a tendency in books of the kind to unnecessarily elaborate the simpler formulæ, and to give the more intricate ones simply as deducible facts, leaving out the steps which lead up to such deductions, to the great discomfort of the student.

---

## ELECTRIC TRACTION IN AUSTRALIA.

[FROM OUR SPECIAL CORRESPONDENT.]

(*Concluded from page* 29.)

To continue the description of the Military Road Electric Tramway, as detailed in Mr. Clement's paper, the next item of interest is the trolley wheel and fork. The pole is set in a hollow casting and held by set screws, and is capable of moving in a vertical plane through an arc of 90 degrees, and in a horizontal plane through an arc of 220 degrees, the necessary tension being given by a set of three spiral springs, revolving with the pole in the horizontal plane, and arranged so that the tension may be adjusted and kept approximately constant throughout a considerable range. On the other end of the pole is fixed the fork which carries the trolley wheel. A wrought iron head is screwed and clamped to the pole, and the fork is mounted on a ball race, which in turn is attached to the head by means of a knuckle

joint. Should the trolley leave the track and foul a wire, the joint is operated and should free the wheel. The object of the ball bearing at the foot of the fork is to allow the trolley to adjust the plane of its rolling diameter to suit the varying relations of the overhead wire and the track. The trolley wheel is bored and fitted with a white metal bushing, forced into place. The spindle is of hard steel and does not rotate. Oil ways are cut in the bushing to allow of lubrication. Contact is made through the bushing and spindle. No supplementary contacts are provided, and the cars have taken two trailers with considerably over 200 passengers up the 1 in 16 grade, without trouble from heating.

The motor cars are rated as 22 seats, having 16 feet bodies and being 23 feet over dasher rails. They are four-wheeled cars with composition steel and cast iron trucks with 32½ inch wheels, cast iron centres and Vicars steel tyres and 3¼ inch axles. No. 1 car is fitted with two Thomson-Houston motors, weighing 2,060 lbs. each complete. Gramme ring armatures, each 1 ohm resistance, the fields being wound with two coils connected in series and 1·8 ohms resistance, and 1·2 ohm on the loop. Ratio of speed reduction, 478 to 1; face of gear, 4½ inches. Thomson-Houston rheostat, composed of alternating strips of sheet iron and mica, with a sliding arm driven by means of a steel cable from either end of the car. In a similar manner the switch for reversing the current through the armatures is operated from the platforms. These motors are operated in series with a resistance for starting through, and originally when the starting lever was hard over or "full open," the fields were weakened to enable the motors to run at higher speeds on slightly falling grades. But this arrangement was a frequent source of trouble. One of the original motor men was an old locomotive driver and his freaks were numerous; no amount of supervision and remonstrance could induce him that time should not be "made up" on the up grades. His railway training taught him so, and, if it didn't suit the electrical gear, the gear must be wrong. As the loop method of altering the fields was used, this connection was dispensed with. As before mentioned, the switches are operated by a cable; there are two handles—both detachable—one to operate the reversing switch, and the other the main switch and rheostat. On either platform is fixed an upright hollow spindle carrying a sprocket wheel on the lower end, and, by means of a chain connected to the endless cable, the main switch is moved as desired. Passing through this hollow shaft is a second spindle, likewise carrying a sprocket wheel, which, by means of its endless cable and connection to the reversing switch, operated by its lever, the car may be moved in either direction. Only two handles being supplied, the operation of the switches can only take place from one end of the car at one and the same time. The reversing switch can be operated independently of the main switch. Immediately over the driver's head is the usual main switch.

Trail cars seating 16 passengers are used; length over body 12 feet, over dasher rails 18 feet 6 inches, and weighing 2 tons empty. Cast steel wheels 23 inches diameter. As many as 180 passengers have ridden on a tram at one time, the tram consisting of one motor and one trail car.

Nos. 2 and 3 cars were each fitted with two 10-H.P. double reduction T.H. motors. More than 50 per cent. of the serious breakdowns on first opening this line were due to failure of the gun-metal pinions. It was found that an inexperienced hand being put on the job of cutting these pinions, a number of them were finished with the teeth slightly inclined instead of radiating, the teeth would not mesh, and often bottomed, the sudden application of the load producing shearing stresses too great for the material. This difficulty once ascertained was immediately rectified, and the pinions would run from 5,000 to 7,000 miles, when the lost motion would necessitate removal. Some of the spurs were of cast-iron, others of steel, the intermediate spurs of cast-iron solid. Early in the present year G. E. 800 motors and K controllers replaced the equipment on Nos. 2 and 3 cars, the nose suspension being used.

A new General Electric four-pole generator is used compound-wound, giving 120 amperes and 500 volts at 450 revs. per minute, having cast steel field magnets, slotted armature, and 208 part commutator. This machine was over compounded 5 per cent., but in order to utilise the battery to the fullest extent, the series coils were placed in parallel, and the machine at normal speed gives a straight line curve for all loads. This four-pole generator is driven off the cable engines, the electric gear being located in the engine shed for the cable trams. An 8-feet wrought-iron built pulley is attached to the crank shaft at the coupling, and this drives a counter shaft through at 21 inches by ¾-inch patent link belt, a jockey pulley being used, as the centres are only about 12 feet apart. From the counter-shaft the dynamo is driven by a 14-inch double leather belt. The cable race for the main rope forms the link belt race, and consequently the belt is running in the bight of the cable.

*Life of Gear.*—A steel pinion in use on No. 1 car S. R. G. motor ran 18,985 miles at Waverley. Brass bearings on the same motor ran 21,720 miles, and were then destroyed through a careless driver neglecting to attend to the lubrication. Brass bearings on a similar motor have run 23,748 miles and are still in good condition. Gun metal gears on double reduction motors ran 6,000 miles. Magnolia bushings from No. 3 G. E. 800 motor commutator end ran 10,476 miles, showing total wear of $\frac{1}{32}$-inch. Pinion end shows no wear upwards, but falls $\frac{1}{32}$-inch downwards, journals in first-class condition. Trolley wheels last six months, running every day, and re-bushing when necessary.

Steam is supplied by three externally fired tubular boilers, each 7 feet diameter and 15 feet 6 inches long, having a grate area of 33 square feet, and a total heating surface of 1,472 square feet. One boiler will drive the cable and electric plant when the four-pole generator is at work. When running the 50 H.P. Westinghouse engine, two boilers are required; pressure 120 lbs.

There are two complete engine units. The old engines are a pair of double-acting simple non-condensing, by Messrs. John Fowler and Co., Leeds. Cylinders 18 inches diameter, 3 feet stroke, and working at 120 lbs. pressure, and capable of developing 300 H.P. The new engines are of the compound horizontal Corliss type, 19 inches by 30 inches cylinders and 3 inches stroke, and capable of developing 300 H.P. A battery of 250 secondary cells are placed at the end of the line in order to steady the working. Each cell consists of six cylinders of lead, forming alternately the positive and negative plates, the outside cylinder, having a bottom, takes the place of the containing cell, and is of course made negative. This containing cylinder is made of 5 lb. lead, all the others from 3 lb. The lugs for connecting cell to cell are simply lead strip provided in cutting out each cylinder from the sheet. Slotted wood prisms are employed to prevent short circuiting at the bottoms of the plates. The battery room, a wooden building with galvanised iron roof, is well lighted and ventilated, and contains two rows of shelving 2 feet wide, and capable of accommodating 250 cells. Each cell stands on a pine board, 12 inches by 12 inches by 1 inch, and is insulated by three porcelain insulators. 213 cells are at present in use. From tests made, this battery when charged is capable of giving out energy equivalent to about 350 H.P. hours. These cells will give a discharge of 100 amperes for a short time without damage, These 250 cells cost £190 as delivered at the Spit Road.

| | | | |
|---|---|---|---|
| Total capital account ... ... ... .. | £26,696 | 10 | 3 |
| Composed as follows:— | | | |
| Construction of line, including land, &c. ... ... | 17,696 | 4 | 5 |
| Rolling stock, overhead line, equipment, and erection (£7,076 being a transfer from Waverley line) ... ... ... ... ... ... ... | 7,147 | 19 | 2 |
| Machinery ... ... ... ... ... ... | 1,852 | 6 | 8 |
| | £26,696 | 10 | 3 |

| Period. | Motor car miles. | Car miles. | Total working expenses. | Total earnings. | Per cent. working expenses to earnings. | Cost per motor car mile in pence. | Cost per car mile in pence. |
|---|---|---|---|---|---|---|---|
| Sept. 20th, 1893 to „ 19th, 1894 | 38,385 | 43,917 | £2,027 | £1,856 | 109·2 | 12·67 | 11·07 |
| „ 20th, 1894 to „ 19th, 1895 | 38,683 | 46,238 | £2,094 | £1,930 | 108·5 | 12 99 | 10·84 |

Working Expenses.

| | *First year of operation.* Amount. | Cost per car mile in pence. | *Second year of operation.* | |
|---|---|---|---|---|
| Loco. ... | £1,193 ... ... | 6 52 | £1,345 ... ... | 6 97 |
| Traffic ... | 270 ... ... | 1·47 | 363 ... ... | 1·89 |
| Per. way | 564 ... ... | 3·08 | 386 ... ... | 2 00 |
| Total | £2,027 | 11·07d. | £2,094 | 10·86d. |

The average cost per car mile for the last six months is about 7·5 pence.

This line came into operation on September 19th, 1893.

## PAST AND PRESENT OBSTACLES IN THE STORAGE BATTERY DEVELOPMENT.* †

By CARL HERING.

The great and numerous advantages of a satisfactory electric storage battery have been described so often, and are so well recognised and admitted by the unbiassed, that it seems unnecessary to again enumerate and discuss them here. The question which the engineer and constructor should discuss at present is not "Is a battery desirable?" but rather, "Why is it that storage batteries seem to have been unsatisfactory?" and the question which concerns the capitalist is, "Does it pay in dollars and cents to use the storage battery, even if it is kept in a satisfactory condition by the makers?"

The latter question can be disposed of here in a few words. If the makers guarantee to keep the battery in a satisfactory condition for a certain rate per annum, or if they rent them, then it becomes a mere matter of calculation to find whether it pays or not; but this calculation must be made for each specific case, as the cost of the batteries and their maintenance seem at present to be such that an estimate for a general case can hardly be considered conclusive, the margin being in many cases too small. In some specific cases it will be found to be decidedly cheaper, in some it will be doubtful, and in some, decidedly too expensive. Limiting ourselves to this country, and judging in a general way from the number of storage battery installations, it would seem that the price at present (including, of course, the cost of maintenance) is such that in perhaps the majority of cases the margin of profit to the user is so small, or so doubtful, that it does not balance the supposed risk. The commendable practice of renting, relieves the purchaser of this risk, which then leaves the question a mere matter of cost. A material reduction in the first cost and cost of maintenance would, therefore, at once turn the tables in many cases so decidedly in favour of the storage battery, that there would be little doubt left as to the economy, and it would

* Communicated to the Amer. Inst. Elec. Engrs., at the meeting held November 20th, 1895.

† An abstract of this paper appeared in our issue of December 27th.

render the practice of renting unnecessary in most cases. Cheapness, therefore, is one of the most important points which affect the outlook of the storage battery.

To return to the first question, "Why is it that storage batteries seem to have been unsatisfactory?" we must limit ourselves to this country, as probably thousands of tons are and have been in successful use abroad. In Germany, for instance, almost every one of the large continuous current central stations is equipped with a battery plant; in England, they are used very largely for private plants, as also for central stations; an English firm recently claimed to have sold a total of "six miles" of accumulators placed in one continuous row, and a French firm is stated to make several tons a day.

The chief reason why so few storage battery plants exist in this country seems to have been that the accumulator companies have for years been so busy fighting each other's patents, and have spent so much money in this litigation, that they have had neither time nor money left to manufacture and instal their batteries. But all this litigation has now come to an end, thanks to an enterprising company which has bought up all the little life that is left of these historic "pasted plate" patents. This, together with the fact that it is now conceded by many authorities that for many, if not most, purposes, the unpatented Planté type of cell is the better, removes the chief obstacle in the storage battery development in this country. The fact that the companies have been too busy with litigation to attend to legitimate business, has shaken the confidence of the public, who naturally ask, "Where are your batteries in use," the only unsatisfactory answer to which is "Abroad." Much "missionary work" must first be done before public confidence will be restored, and let us hope that the recently started "rental" companies will soon accomplish this. It is up-hill work, but prospects at present seem bright and encouraging.

As the patent question has now been settled, and as cells of the Planté type have now been developed into practical forms, the storage battery outlook at present lies largely in the hands of the constructing engineer, and we should therefore look at the question from this standpoint.

The storage battery has for years had the reputation of being like a delicate, sickly baby, continually threatened with half a dozen diseases, and requiring the constant attendance of a trained nurse, besides the fatherly care and large purse of its manufacturer. To the user the five chief diseases of the accumulators appear to be: buckling, short-circuiting, sulphating, disintegration, and dropping out of the peroxide. Many inventors have thought that most of these may be made uninjurious by a process of opposing or resisting their disastrous effects, as distinguished from preventing their occurrence, although the term "preventing" has incorrectly been used to describe it. Buckling has been opposed by main strength, and sometimes awkwardness, short circuiting by porous insulating sheets between the plates, falling out by enclosing or locking the peroxide so that it cannot drop out, &c. Whether, and how far, such heroic methods have been successful can be determined only by tests, but it seems to the writer that many of the methods are like curing corns by cutting off one's feet, the cures may be effective, but can hardly be called satisfactory. To attempt to prevent the almost irresistible force of expansion of the peroxide from exercising itself by confining the material in an inelastic lead frame, is a formidable, and, it seems, an almost hopeless task; the inevitable result is that one or the other must give way; if it is the peroxide, it will ultimately be crumbled by the pressure; if it is the lead, there will probably be buckling, or, at least, a separating of the contact surfaces at the subsequent contraction of the peroxide, and this inevitably results in the formation of that very objectionable layer of white sulphate which practically insulates the active material from its conductor, the consequences of which are sure to be fatal. The development of the storage battery has been greatly retarded by the fact that it was in the hands of mechanical engineers instead of chemists.

The careful constructor should attack the problem in a different way; he should go back to the beginning to find out the prime causes, and then prevent, if possible, these causes from arising, rather than to attempt to oppose their effect by sheer force and awkwardness. These causes seem now to be understood, and the question, therefore, is how to prevent them. One way is to supply with each battery a printed and neatly framed long list of "dont's" or limitations in the form of rules telling you what you must not do, with a foot-note attached, saying that the company's guarantee ceases if these rules are violated. This may be satisfactory to the company, but certainly not to the user. A more satisfactory way would be to construct the plates, if possible, so that these prime causes of trouble cannot arise, no matter what mistakes the attendant may make, or what emergencies the battery may be called upon to meet—within reasonable limits, of course. To discuss all these prime causes in detail would require writing a treatise on the subject, but they may be summarised briefly, and their prevention will then suggest itself.

The chief evil effects are apparently caused by too rapid charging and discharging. With many of the favourite methods of avoiding the effects of high rates, the capacity and efficiency at such rates both become so low that the user will be discouraged from discharging so fast, and the current will fall so rapidly that it will have little chance to do much mischief. Such methods are applicable only when rapid rates are never desired, but those cases are the exception, rapid rates, or at least a provision for them, being generally very desirable and often essential as in traction work, for instance; such methods have therefore solved this problem only for a limited field. What should be done is to try to construct the plates so that they are adapted to high rates without a great loss of efficiency or capacity. It will be found that in the majority of cases in which the storage battery would be of special value, it is a question of *rate* rather than *capacity*, that is, a great horse-power for a short time is more often required than a large quantity of energy delivered at a slow rate; it seems from a number of cases, about which the writer has recently been consulted, that any capacity above that which is obtained at a one, two, or three hour discharge is generally of comparatively little value.

To study the effects of rapid discharges, it must be remembered that the acid is as important as the lead oxides; when its density falls too low, there will be a lowering of the E.M.F.; acid is withdrawn from the solution during discharge, hence the diluted acid in the fine pores of the active material must get out and denser acid must get in; but the only force which does this is the difference between their specific gravities, and as this is very small, the force will be small, and therefore the circulation will be slow, which in turn reduces the E.M.F. The chemical action will therefore be confined chiefly to the external surface, which is freely exposed to the acid, and the action then becomes so great per unit of surface, that white sulphating, or better, complete sulphating, takes place. If a rapid discharge is not to injure the plates nor lower the voltage by reason of the acid in the pores becoming too dilute, the circulation must be rapid; great porosity accomplishes this partly, but is attended by frailty and poor conductivity of the peroxide, which again results in a fall of the voltage. The ideal method would, therefore, seem to be a vertical lead plate to act as a good conductor with an extremely large surface and a very thin layer of peroxide on it, freely exposed to a large quantity of acid, which is capable of circulating rapidly. That such a plate may be made to have a greater capacity per pound of plate for rapid discharges, and, perhaps, an equal one for slow discharges, as compared with the best thick, porous plates, has been shown by experiments. The great capacity is doubtless due to the fact that the active material is more completely utilised, as it is all close to the conductor and freely exposed to the acid. The capacity of such a plate will evidently be affected only slightly by the rate, and the loss of voltage, and therefore the watt efficiency, will depend more on the conductivity of the lead, than on the acid becoming too dilute in the immediate neighbourhood of the active material. To obtain high rates accompanied by good efficiency and capacity, there is little doubt that the best way is to use large freely exposed surfaces, rather than to try to resist the evil effects of high rates, mechanically.

In rapid charging the acid becomes too dense in the pores of a thick mass of active material if the circulation does not keep pace with the demand; this dense acid softens the peroxide and there is a tendency to form gases when the proper chemical action cannot keep pace with the current. Both the softening of the peroxide and the mechanical effects of the gases are injurious. What was said regarding porosity and the ideal plate applies, therefore, also to the charging.

The negative plates being soft and tough, are not so easily injured, but unless the acid can circulate very freely there will still be a lowering of the voltage as with the positive plates, and probably also a lowering of the ampere-hour capacity.

The contact between the peroxide and its conductor must be very good, for, if poor, then a white sulphate forms at the surface, which practically produces an insulating layer, and disastrous effects are then inevitable. The ideal contact is obtained when the peroxide is formed on the lead electrolytically, as in the Planté processes.

The peroxide will insist on expanding during the discharge, and on contracting during the charge. It would be much better to accept this as an inevitable fact than to try to keep the material from obeying the laws of nature by forcibly confining it within an inelastic frame, as many inventors have attempted to do; the results of such an attempt have already been described. To hold a large mass of active material firmly in contact with a lead conductor, when one expands and contracts while the other does not, or expands without afterwards contracting again—is a difficult matter. The best solution seems to be, to have the active material in the form of an extremely thin layer over a large surface and formed from the lead itself, as this increases its adhering properties. If such a layer can be made porous, and if the surface is made up of small facets, there will be little tendency to buckling or scaling.

The gradual washing away of the surface of the peroxide, and the slow peroxidation and consequent disintegration of the lead support, seem to be absolutely unavoidable. Until some preventative is found, if it ever will be, it seems wisest to accept the inevitable and acknowledge that the positive plates are perishable. To use any other metals or carbon, is out of the question; the addition of antimony to the lead seems to retard, but does not prevent, peroxidation. The favourite method of trying to avoid the effects of disintegration is to make the frames of the positive plates quite thick, thus prolonging their life. This, if not accompanied by other disadvantages, may be satisfactory for stationary plants, in which the great additional weight is no hindrance, the only objection to it being the cost of the metal, which is no small factor in the total cost of the plate. But such a method is certainly not satisfactory for cheap or portable cells, and the gradual washing away of the peroxide remains the same, whether the frame is heavy or light, provided that the surface exposed to the liquid is the same.

But there is another way of meeting these unavoidable effects of use, which has recently been applied, and which seems to be a much more rational and effective solution of this vexed problem, at least when lightness and smaller first cost are desired. Instead of making the positive plates heavy and expensive, they may be made very light, cheap, and easily replaceable; their life may then be shorter, but the battery will be as good as new whenever these perishable parts have been renewed; their life is soon known to the user, and he can then readily determine for himself how much he must allow for amortisation. Anyone who has urged the use of accumulators, will appreciate the great value of being able to satisfy the user as to the amortisation factor. A purchaser will believe you if you admit that the life of the perishable parts will be comparatively short; but he will not believe you if you say it will be long, even if you are telling the truth.

But such a method, to be successful, requires that the old plates and sludge can be converted at a small cost into new plates; this, it seems, can now be done, and the writer believes that this alone will have a very important bearing on the outlook of the storage battery, at least for portable cells that are required for traction and many other purposes, or for both portable and stationary plants, if the first cost is an important factor. Such a method becomes practicable only when the chief factor in the cost of the plate is the material, the cost of labour and forming being small.

For stationary purposes, in which the only objection to the weight is the first cost of the lead, good storage batteries have been used abroad with success for some time, provided the rates of charge and discharge are kept low. Assuming that the same storage batteries may be made in this country as well, the question which affects the outlook here is then only one of the cost. But neither abroad nor here does there seem to be a battery in the market in which the weight has been sufficiently reduced, and the rate sufficiently increased for a really successful traction battery, the success of which has been demonstrated beyond dispute. It is here assumed that to the public and to railway companies, traction batteries are not a demonstrated success until a traction company, which has no affiliation with the accumulator makers, finds it to its own advantage to use them in preference to other systems. That accumulator traction is the ideal system has been repeatedly acknowledged by good authorities, and that this field for batteries is very large, and, perhaps, larger than that for stationary work, is likely. The large first cost and cost of maintenance of the overhead construction for trolley roads, the large power station required, and the threatened damages done by electrolysis, would doubtless turn the tables in favour of the storage battery for many long roads on which traffic is not too dense, and, possibly, also for many suburban steam roads.

It seems to the writer that the only batteries which have a promising outlook for this very trying work are those which have a very large surface, very small depth of active material formed electrolytically, and a very free circulation of the acid. The lead frames should be made only thick enough for proper conduction, the batteries must be cheap in first cost, and the positive plates should be capable of being replaced comparatively frequently at small cost. They should be proportioned so that a discharge corresponds to one trip of the car—and only one. To claim as an advantage that a battery can run a car, say four trips, is mere deception, and to the intelligent engineer it is simply an admission that it can do no better. No one would think of carrying four relays of horses on a trailer of a horse car, and why should the equivalent be done with the storage battery, unless it is that the battery can do no better, and that it cannot be discharged rapidly enough so that the capacity and weight may be reduced to that required to run only one trip? The ideal is certainly a single trip discharge. If the rate for a four-trip battery could be increased four times without materially affecting the capacity, its weight and capacity for a single trip discharge would evidently need be only one-fourth as great. The charging rate should also be equal in hours to the discharge rate, or else it will take a plant of more than two sets of batteries to a car.

These various ideals mentioned above would have only a theoretical and not a practical interest, were it not for the fact that recent tests have shown that a near approach to them has apparently been reached; it is somewhat premature at present to say more until the results of the tests have been confirmed by practice.

The above discussion may be briefly summarized as follows:—Cessation of litigation and the development of the Planté type of cells, make the storage battery outlook in this country much brighter; the cost of a guaranteed storage battery seems in many cases to be too nearly equal to that of the direct generators to encourage their general adoption. A reduction in the cost would, therefore, open a large field, much larger than in proportion to the reduction; the renting of accumulators seems a commendable method for introducing them. Most of the diseases which storage batteries are subject to could be avoided, or made much less disastrous, by having large surfaces, small depths of active material, and free circulation. The first cost would be reduced, and the vexing question of the uncertain amortisation settled, by a light, short-lived, cheap positive plate, and a cheap process of reconverting old into new positive plates. Storage batteries for slow discharges have been a success abroad; a very large additional field would be opened by a light, cheap, rapid-rate cell.

The objection to a plate with a thin layer of active material is, that it may not retain its charge as well as one with a thick layer or pellets, but in most cases in which rapid rates are desired or cannot be avoided, the small loss in standing is probably more than balanced by the fact that the plates are not injured by rapid rates. As a rule, long periods between charges go hand in hand with slow discharges and less objection to great weight, while short periods between charges, high rates of discharges and lightness, usually go together.

In conclusion, the writer desires to take this opportunity to make the following recommendations in the interests of engineers who may have to calculate accumulator plants:—

That rates of charge and discharge be designated in *hours* and fractions, the current (or for power purposes, the watts), during that time being considered to be kept constant. There can then be no mistake as to what is meant, as this represents the time in hours during which a cell will continue to give a practically constant current before the voltage falls below its limit.

That efficiencies and capacities be always accompanied by the corresponding rate in hours.

That in giving an efficiency, it should always be stated whether it is for ampere hours or for watt hours.

That for portable batteries intended for power purposes, the capacity be given in watt-hours instead of ampere-hours, and that the weight given be that of the complete cell ready for use, as distinguished from the weight of the plates alone.

## PROVISIONAL ORDERS.

THE following is a list of applications for provisional orders deposited with the Board of Trade on or before December 21st, 1895, under the provisions of the Electric Lighting Acts, 1882 to 1890.

| Title of order and description of area. | Name of promoters. | Agents. |
|---|---|---|
| Allerton, Woolton, Childwall, and Garston Electric Lighting Order. The Urban Districts of Allerton, Little Woolton, Much Woolton, Childwall, and Garston. | Liverpool District Lighting Company, Limited. | Messrs. Ayrton, Radcliffe & Wright, 9, Cook Street, Liverpool. |
| Ambleside Electric Lighting Order. The Urban District of Ambleside. | Windermere and District Electricity Supply Company, Limited. | S. Morse, Esq., 4, Fenchurch Avenue, E.C. |
| Ashton-on-Mersey Electric Lighting Order. The Urban District of Ashton-on-Mersey, and a portion of the District of the Bucklow Rural District Council. | Altrincham Electric Supply, Limited. | Messrs. Lewin, Gregory & Anderson, 13, King Street, Whitehall, S.W. |
| Bath Electric Lighting Order. The City of Bath. | The Corporation. | Messrs. Crawley, Moger and Co., 4, Bloomsbury Square, W.C. |
| Bath Electric Lighting Order. The City of Bath. | City of Bath Electric Lighting and Engineering Co., Limited. | Edward B. Titley, Esq., 14, Orange Grove, Bath. |
| Bray Township Electric Lighting Order. The Township of Bray. | The Township Commissioners. | Messrs. Clay and Close, Chorley House, Bloomsbury Square, W.C. |
| Bristol Suburban Electric Lighting Order. The Urban Districts of St. George and Kingswood, and a portion of the Urban District of Stapleton and of the Rural District of Warmley. | Great Western Electric Light and Power Company, Limited. | Messrs. Walter Webb and Co., 23, Queen Victoria Street E.C. |
| Colwyn Bay and Colwyn Electric Lighting Order. The Urban District of Colwyn Bay and Colwyn. | The Urban District Council. | J. C. Ball, Esq., 16, Parliament Street, S.W. |
| Cork Electric Lighting Order. The City or Borough of Cork. | The Corporation. | Messrs. Holmes, Greig & Greig, 18, Abingdon Street, Westminster, S.W. |
| Cowes Electric Lighting Order. The Urban District of Cowes. | The Urban District Council. | Messrs. Martin and Leslie, 27, Abingdon Street, Westminster, S.W. |
| Devonport Corporation Electric Lighting Order. The County Borough of Devonport. | The Corporation. | Messrs. Sherwood and Co., 7, Great George Street, Westminster, S.W. |
| Folkestone Electric Lighting Order. The Urban District of Folkestone. | The Corporation. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Gloucester Corporation Electric Supply Order. The City of Gloucester. | The Corporation. | Messrs. Sharpe and Co., 9, Bridge Street, Westminster, S.W. |
| Godalming Electric Lighting Order. The Municipal Borough of Godalming. | The Corporation. | Messrs. Baker & Co., 22, Great George Street, Westminster, S.W. |
| Great Berkhamsted and Northchurch Electric Lighting Order. Portions of the Parishes of Great Berkhamsted and Northchurch. | Bedford Electric Light Company, Limited. | Messrs. E. & F. Mote, 1, South Square, Gray's Inn, W.C. |
| Great Crosby and Waterloo Electric Lighting Order. The Urban Districts of Great Crosby and Waterloo-with-Seaforth. | Liverpool District Lighting Company, Limited. | Messrs. Ayrton, Radcliffe & Wright, 9, Cook Street, Liverpool. |
| Huddersfield Electric Lighting Order. The County and Municipal Borough of Huddersfield. | The Corporation. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Ipswich Electric Lighting Order. The Borough of Ipswich. | County of London and Brush Provincial Electric Lighting Company, Limited. | S. Morse, Esq., 4, Fenchurch Avenue, E.C. |

| Title of order and description of area. | Name of promoters. | Agents. |
|---|---|---|
| Keswick Electric Lighting Order. The Urban District of Keswick. | The Urban District Council. | Messrs. Sharpe and Co., 9, Bridge Street, Westminster, S.W. |
| Keswick Electric Lighting Order. The Township of Keswick and portions of the Townships of St. John's, Castlerigg, and Wythburn, Underskiddaw and Above Derwent. | Keswick Electric Light Company, Limited. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Kettering Electric Lighting Order. The Urban District of Kettering. | The Urban District Council. | Messrs. Baker & Co., 22, Great George Street, Westminster, S.W. |
| King's Lynn Electric Lighting Order. The Borough of King's Lynn. | The Corporation. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Kingstown Township Electric Lighting Order. The Township of Kingstown. | The Township Commissioners. | Messrs. Clay and Close, Chorley House, Bloomsbury Square, S.W. |
| Liverpool Electric Lighting Order. The City of Liverpool. | The Corporation. | Messrs. Sherwood and Co., 7, Great George Street, Westminster, S.W. |
| THE COUNTY OF LONDON. | | |
| Battersea Electric Lighting Order. The Parish of St. Mary, Battersea. | The Vestry. | W. W. Young, Esq., 24, Ely Place, E.C. |
| County of London (South) Electric Lighting Order. The District of the St. Saviour's District Board of Works, and the Parishes of St. Mary, Newington; St. Mary, Lambeth; St. Giles, Camberwell; and St. Mary, Battersea. | County of London and Brush Provincial Electric Lighting Company, Limited. | S. Morse, Esq., 4, Fenchurch Avenue, E.C. |
| Newington Electric Lighting Order. The Parish of St. Mary, Newington. | The Vestry. | L. J. Dunham, Esq., Clerk to the Vestry, Vestry Hall, Walworth Road, S.E. |
| Manchester Electric Lighting Order. A portion of the City of Manchester. | The Corporation. | Messrs. Sharpe & Co., 9, Bridge Street, Westminster, S.W. |
| Margate Corporation Electric Lighting Order. The Borough of Margate. | Do. | Do. |
| Merthyr Tydfil Electric Lighting Order. A portion of the Urban District of Merthyr Tydfil. | J. C. Howell, Limited. | Messrs. Deacon, Gibson & Medcalf, 9, Great St. Helens, E.C. |
| Middleton Electric Lighting Order. The Borough of Middleton. | The Corporation. | Messrs. Baker & Co., 22, Great George Street, Westminster, S.W. |
| Newmarket Electric Lighting Order. The Urban District of Newmarket and a portion of the Rural District of Newmarket. | Newmarket Electric Light Company, Limited. | Messrs. Rees & Frere, 5, Victoria, Street, Westminster, S.W. |
| Pembroke Township Electric Lighting Order. The Township of Pembroke. | The Township Commissioners. | Messrs. Holmes, Greig & Greig, 18, Abingdon Street, Westminster, S.W. |
| Prescot District Electric Lighting Order. The Urban District of Huyton-with-Roby, and the Parishes of Rainhill, Whiston and Eccleston. | British Insulated Wire Company, Limited. | S. Morse, Esq., 4, Fenchurch Avenue, E.C. |
| Queenstown Township Electric Lighting Order. The Township of Queenstown. | The Town Commissioners. | Messrs. Holmes, Greig & Greig, 18, Abingdon Street, Westminster, S.W. |
| Rathmines and Rathgar Township Electric Lighting Order. The Township of Rathmines and Rathgar. | The Improvement Commissioners. | Do. |
| Sale Urban District Council Electric Lighting Order. The Urban District of Sale. | The Urban District Council. | Messrs. Sharpe & Co., 9, Bridge Street, Westminster, S.W. |
| Wells (City of) Corporation Electric Lighting Order. The City of Wells. | The Corporation. | Messrs. Sismey and Sismey, 11, Serjeants' Inn, Fleet Street, E.C. |

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Compiled expressly for this journal by* W. P. THOMPSON & Co., *Electrical Patent Agents*, 31, *High Holborn, London, W.C., to whom all inquiries should be addressed. Copies of any of the specifications may be obtained of* Messrs. W. P. THOMPSON & Co., *price, post free*, 8½*d. (in stamps.)*]

### NEW PATENTS.—1895.

24,577. "Improvements in movable supports for movable flexible electric conductors." T. LAURIE. Dated December 23rd.

24,578. "Improvements in the application of electricity to vehicles on tram and railways, and in the apparatus for effecting the same." D. URQUHART and F. WYNNE. Dated December 23rd.

24,594. "Improvements in electric lifts." J. S. STEVENS, and C. G. MAJOR. Dated December 23rd.

24,618. "Improvements in telephony." C. ADAMS-RANDALL. Dated December 23rd.

24,622. "Mercury gravitation safety valve and pressure gauge for kitchen and certain low pressure boilers for electric machinery, engines, and water heaters." C. MACKINTOSH. Dated December 23rd.

24,630. "Improvements in dynamo-electric and electro-dynamic machines." W. H. TREGASKIS. Dated December 23rd.

24,680. "Improvements in electric lighting of cycles, carriages, and other vehicles, and portable and any other lamps." P. H. EMANUEL, and H. G BAKER. Dated December 24th.

24,706. "System of electric telegraphy and central station connections and apparatus therefor." G. C. MARKS. (Wm. H. Cooley, United States.) Dated December 24th.

24,710. "Improvements in lightning arresters for high potential electric circuits." J. DEVONSHIRE. (W. B. Potter, United States.) Dated December 24th.

24,711. "Improvements in or relating to electric brakes." J. DEVONSHIRE. (W. B. Potter, United States.) Dated December 24th.

24,716. "Improved switch for tramways, electric railways, and the like." L. PRITZIUS and F. STRAUBE. Dated December 24th.

24,735. "Improvements in electric arc lamps or lighting apparatus." W. H. SMITH. Dated December 24th.

24,800. "Improvements in and relating to electric light adapters for oil lamps and candlesticks." J. B. MEIKLEJOHN. Dated December 27th.

24,834. "Improvements in electric accumulators." C. THERYC and A. OBLASSER. (Date applied for under Patents, &c., Act, 1883, Sec. 103, June 28th, 1895, being date of application in France.) Dated December 27th.

24,836. "Improvements in electrically operated windlasses." G. ASMUSSEN. Dated December 27th.

24,837. "Improvements in the method and apparatus for washing alkali-amalgam obtained in electrolytic apparatus." P. JENSEN. (H. C. F. Störmer, Norway.)

24,851. "Development and combination of the telephone and the phonograph." J. E. O. KUMBERG. Dated December 28th.

21,852. "Insulating material for electrical purposes." W. P. ADAMS. Dated December 28th.

24,868. "Improvements in recording instruments for telegraphic and other purposes." W. THOMSON, Baron KELVIN. Dated December 28th.

24,884. "Automatic switch for electric water heater." J. W. EWART and G. EWART. Dated December 28th.

24,885. "Improved apparatus for electrically controlling the supply of gas and other fluids, and for like purposes." J. R. C. GALE. Dated December 28th.

24,888. "Improvements in hinges or joints for electrical purposes." G. W. GOLDBING. Dated December 28th.

24,892. "Improvements in regulators for dynamo electric machines." P. R. JACKSON & Co., LIMITED, and J. S. LEWIS. Dated December 28th.

24,895. "Improvements in dynamo-electric machines." P. R. JACKSON & Co., LIMITED, and J. S. LEWIS. Dated December 28th.

24,905. "Improvements in and relating to telephone transmitters." T. J. ROBKE. Dated December 28th.

24,945. "Improvements in and relating to carbon holders for electric arc lamps." H. J. FISHER. Dated December 30th.

24,949. "Improvements in electric arc lamps." S. S. ALLIN. Dated December 30th.

25,002. "Improvements in electrolytical apparatus." R. HEATHFIELD and W. S. RAWSON. Dated December 31st.

25,019. "Improvements in apparatus for massage and electro-massage." G. ROSSBACH. Dated December 31st.

25,053. "Improved combined portable electric lamp, switch, and battery." R. T. GLOVER and J. G. GLOVER. Dated December 31st.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS.
### 1895.

Specifications Nos. 523 and 1,714, abstracted in our last issue, were incorrectly dated 1894 instead of 1895.

107. "Improvements in primary batteries." E. M. LEVETUS, H. LEVETUS, and W. ROWBOTHAM. Dated January 2nd. One of the elements is utilised to divide the cell into two parts, each occupied by exciting solution. The heat due to the chemical action which takes place when the cell is working, causes the fluid to circulate, holes being provided at the top and bottom of the dividing element for this purpose. 3 claims.

226. "Improvements in electric call and alarm apparatus." E. HERZ, of St. Johann-Saarbruchen, and J. P. HARTFUSS MERZIG, Germany. Dated January 3rd. Relates to the combination of a plurality of open electric circuits, an electric signalling device in each circuit, an adjustable contact arm adapted to be traversed by the current, and forming the one termination of each open electric circuit, a rotary frame common to all the circuits adapted to be traversed by the current, and forming the other termination in common of all the open circuits, means for preserving the orientation of said frame, a clock for operating the circular movement of the frame, and a plurality of contact members on the said frame, adapted severally to have contact with the aforesaid contact arms, and thus complete the respective circuit. 11 claims.

281. "Improvements in and connected with telephones." H. OPPENHEIMER. Dated January 4th. Relates to means for adjusting the distance of the magnets from the diaphragm in receivers of the "Bell" type. This is done by screwing the magnet back and forth by means of a screw, having its bearing in the case of the receiver to which the magnet is not rigidly connected. An improved form of terminal is also described. 2 claims.

437 A. "Improvements in and connected with arc lamps." J. B. BARTON (W. Jandus). Dated January 7th. The arc is enclosed by two chambers, which, without being absolutely air-tight, only permit a limited supply of air to enter. The length of time which the carbons will burn is thereby prolonged. 3 claims.

671. "Improvements in magnetic cut-outs." L. ANDREWS. Dated January 10th. The cut-out for disconnecting an alternator or transformer from the omnibus bars when the machine is temporarily disabled, is wound with two coils, one in series with the machine, the other a thin coil connected across the omnibus bars or across the secondary of a transformer excited by the bars. These coils are arranged so that as long as the current in the generator is pulsating synchronously and in phase with the current in the omnibus bars, the combined effects of the two coils do not permit the cut-out to act. If, however, the currents differ in phase from any cause, the generator is cut out of circuit. 1 claim.

1,906. "Improvements in electric condensers." G. THRELFALL (R. Threlfall). Dated January 26th. Condensers are built up of sheets of paper, &c., soaked in paraffin wax, or the like, alternating with sheets of metal. In order to eliminate air, the dielectric sheets are floated before soaking in the melted wax, and after the condenser is put together the air is exhausted at a temperature of 130° C. The exhaustion of air is carried out three times in succession with readmission of air between each. 2 claims.

2,816. "Improvements in secondary batteries." F. KING, 4, Great Winchester Street, London. Dated February 8th. Consists in forming webs or ridges on the conducting plate to constitute the boundary of the surfaces of the finished plate holding the active material. The active material is maintained against the conducting plate, by means of a perforated or porous diaphragm of non-conducting material. To more effectively ensure the permanence of contact between the active material and conducting plate, the electrodes of opposite denomination are each built into a metallic frame by allowing convenient portions of the conducting plate to protrude from the perforated diaphragm and soldering these protruding portions to a metal bar, this fixing the proper distance apart of the electrodes. 3 claims.

3,003. "Improvements relating to the regulation of electric motors." W. P. THOMPSON, 31, High Holborn, London (E. Lauhoffer, A. Burghardt, and J. Burghardt, Mulhausen, Alsace, Germany.) Dated February 11th. The invention is designed to secure continuous alteration of the number of revolutions of the motors in such manner as to insure the motor working with maximum efficiency at any given load, by means of the application of a system of mains having different potentials, which are as a geometrical series in combination with corresponding alterations of the magnetic field of the motors. The armature of the generating dynamo is wound with several turns inserted in series and in a geometrical ratio. Between each two of the current circuits a derivation of current can take place. 5 claims.

3,578. "Improvements in railway signalling apparatus." W. H. WALSH. Dated February 19th. Relates to apparatus for giving notice to the engineers of two trains approaching a crossing, of the position of their respective trains, in time to stop one of the trains while the other advances over the crossing. Also means are provided so that the train on a crossing circuit can signal to a train following it on the same track, so as to prevent a rear end collision should the first train stop on the crossing. A further object is to prevent collisions at a branch or switch. 3 claims.

11,728. "Improvements in electric switches for use in connection with galvanic batteries, applicable also for other purposes." W. SHAW. Dated June 17th. Relates to a switch which automatically at regular intervals switches off one set of cells and switches on another of two or more sets of cells. By this means a set of cells which has been in use has time to recuperate, while a second or two or more sets in succession are brought into use; the current given off by the entire set is therefore maintained constant for a long period. 4 claims.

13,900. "Improvements in galvanic batteries." R. W. GORDON. Dated under convention January 31st. Relates to a cell in which zinc is the positive element, copper or iron the negative element, and black oxide of copper the depolariser, the exciting fluid being a solution of caustic soda. The depolariser is contained in a cage of perforated copper or iron forming the negative element. The positive element is suspended from the lid of the cell and inside the cage, the whole being immersed in the exciting liquid. 5 claims.

14,858. "Improvements in electric meters." J. HARRIS, 116, Pine Grove Avenue, Lynn, Mass, U.S.A. Dated August 6th. In this meter the current passing through the current coil produces a torque upon the pressure coil, which throws it to the right and through the connection to a reversing switch, which causes the motor to turn in such direction as to wind up a coil until the torque of the spring balances the torque of the current and pressure coil, when it stops, and according to the fluctuations of the current the pencil line will indicate and record the number of watts passing through the meter. 5 claims.

15,686. "Improvements in electric railways." J. F. MCLAUGHLIN, Philadelphia, U.S.A. Dated August 20th. The invention refers to railways in which underground switches for coupling a supply conductor to feeding conductors or contacts are operated by travelling electro-magnets on the car, and the objects of the invention are to provide a switch which shall be positively locked when in its open position, and unlocked and closed only when covered by a motor car, also to provide means for collecting the current from the exposed contacts, and guard against a failure of the system. 12 claims.

16,910. "Improvements in and relating to power transmitting mechanism for the power shafts of electric and other high-speed motors." D. S. REGAN. Dated September 10th. Relates to reduction gearing for transmitting power from shafts running at a high speed, such as an electric motor spindle. The gearing comprises an eccentric keyed on the shaft, a gear wheel being loosely mounted on the eccentric and meshing with an internal gear wheel, and also an external gear wheel. These latter gears are mounted loosely on the shaft, and when one of them is held stationary, the other one is rotated at a speed less than that of the shaft. 4 claims.

16,925. "Improvements in electric fire alarms." C. D. TISDALE and J. D. GOULD. Dated September 10th. A fusible wire forms part of a circuit, being in parallel with a lamp and alarm circuit, which is kept open by means of an electro-magnet in series with the fusible wire. Consequently when the wire breaks the current ceases to flow round the magnet, and the alarm circuit is therefore completed. 2 claims.

17,436. "Improvements in thermo electric generators, and the method of operating same." H. B. COX, of Hartford, Connecticut, U.S.A. Dated September 18th. Relates to an improved method of heating one surface of a thermo-electric generator or battery of generators by means of a heated moving fluid. This fluid preferably consists of air which is heated by means of a Bunsen or other suitable gas flame or furnace. The heated air passes into a conduit which communicates with the interior of the generator. 7 claims.

17,442. "Improvements in electric resistances." L. B. STEVENS, Darlington Works, Southwark Bridge Road, London. Dated September 18th. Relates to a variable resistance formed of a series of carbon blocks, which may be pressed together as desired. The carbon blocks are contained in the trough of insulating material. At one end of the series is a fixed metallic block, which forms one terminal of the resistance, and at the other end a movable metallic block forming the other terminal, the movable block is moved back and forth so as to press and loosen the carbon blocks by means of a screw. 2 claims.

17,603. "Improvements in electric batteries." M. M. BAIR, 12 and 33, Rue de Lorraine, Levallais-Perrel, near Paris, France. Dated September 20th. Consists in affixing the agglomerate rod or blocks of a Leclanché cell to the carbon electrode by means of bolts, studs, or pins made of material that is unaffected by the action of the electrolyte employed. The two agglomerate blocks are arranged on opposite sides of the carbon plate, to which latter the blocks are connected by means of two bolts, each bolt has a nut at one end, and at its opposite end an eye for the reception of the zinc rod. These bolts are insulated or are of insulating material so as to avoid short-circuiting of the cell between the two electrodes. 2 claims.

18,033. "Improvements in or relating to developing magnetic phases and producing rotary magnetic fields." W. P. THOMPSON (C. S. Bradley). Dated September 26th. Relates to devices for producing rotary magnetic fields from a single phase alternating current with one pair of mains. The object is attained by means of a compound coil of two wires joined in parallel to the supply main. One of the wires has a capacity in series with it, and the other has inductance, these being so arranged that the resultant magnetomotive force due to both coils lags 90°, or a quarter period behind the magnetomotive force due to a simple coil in series with the mains. From these two magnetomotive forces, currents differing in phase by 90° may be obtained, or the coils themselves may form the primary circuit of an induction motor. 4 claims.